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JOURNAL OF PALEONTOLOGY

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TRILOBITE FAUNA OF THE UPPER CAMBRIAN HONEY CREEK FORMATION

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ABSTRACT—An abundant trilobite fauna of early Franconian age is described from the late Cambrian Honey Creek formation. The fauna is representative of the *Elvinia*, *Ptychopleurites* and *Conaspis* zones. Nine new genera, and seventeen new species are described. The scope of the Honey Creek formation is redefined on the basis of the lithology and fauna.

THE Honey Creek formation of late Cambrian age is exposed only in the Arbuckle and Wichita Mountains of Oklahoma. It is underlain by the Reagan sandstone which rests on pre-Cambrian igneous rocks, and is overlain by the Fort Sill limestone, the lowermost formation of the Arbuckle Group. The Honey Creek formation contains an abundant trilobite assemblage of lower Franconian age that includes the *Elvinia*, *Ptychopleurites*, and *Conaspis* faunas. Previous investigators have described a few of the forms, but a complete study of the trilobites has not previously been made.

The occurrence and description of *Camaraspis convexa* (Whitfield), *Camaraspis plana* Frederickson, *Camaraspis parabola* Frederickson, *Dokimocephalus curta* (Resser), *Dokimocephalus intermedia* (Resser), and *Kindbladia wichitaensis* (Resser) from the *Elvinia* zone, and *Ptychopleurites amplooculatus* Frederickson from the *Ptychopleurites* zone were discussed in a previous paper (Frederickson, 1948b). The present paper completes the study of the Honey Creek trilobite assemblage from collections which I made during the summers of 1938 and 1940.

The Honey Creek formation was named originally by Ulrich (1911, p. 661) but the type section was not designated until later (Ulrich, 1932, pp. 742–743). Ulrich recognized the faunal zones delineated in this paper, but also included the *Ptychaspis* zone in the Honey Creek formation. He noted that the latter "is more limy and much less glauconitic than the underlying beds." He further stated that an unconformity is present between the Honey Creek formation and the overlying Fort Sill formation, and that the thickness of the former varies "owing primarily to the removal of the upper beds which constitute the *Ptychaspis* zone."

I have found no evidence of this unconformity. On the contrary, in every section examined the *Ptychaspis* zone was found to be present, although it occurs in thin-bedded fine grained limestones of typical Fort Sill lithology a minimum of forty feet above the characteristically glauconitic Honey Creek beds.

Therefore, the *Ptychaspis* fauna is in-

cluded in the Fort Sill formation and the *Taenicephalus* subzone of the *Conaspis* zone is considered the marker horizon for the upper part of the Honey Creek formation. The contact between the two formations in most areas can be readily determined lithologically by the change from the typical glauconitic coarsely crystalline Honey Creek limestones to the overlying dense, fine-grained limestones of the Fort Sill formation.

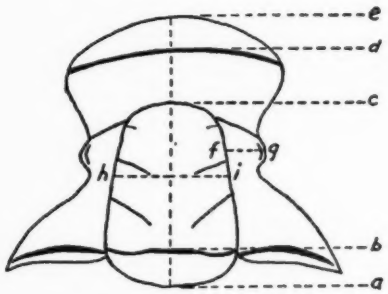


FIG. 1.—Diagram of cranidium of *Parabolinoides contractus* showing measurements of cranidium; a–b = width of occipital ring; b–c = length of glabella; c–d = width of brim; d–e = width of border; a–e = length of cranidium; f–g = width of fixed cheek; h–i = width of glabella at midpoint.

The Cap Mountain formation which Ulrich (1932, p. 742) described as being below the Honey Creek formation in the eastern Arbuckle Mountains, and the "basal limestone" which Decker (1939a, p. 17; 1939b, p. 1097) described from the Wichita Mountains have been assigned previously to the Honey Creek formation (Frederickson, 1948a, p. 1349).

Fossils from the Honey Creek formation commonly are well preserved in a limestone matrix, although a few molds have been obtained from sandstone lenses. The specimens from the limestone are either calcareous casts preserving all features of the test, or internal and external molds. The molds generally do not show details of the carapace surface and ornamentation as well as do the replaced tests. Matrix was removed from the specimens by the use of a Burgess vibrotool, dental drills and chisel-edged needles.

At the present, no general agreement exists among the students of Cambrian trilobites as to the method of measuring various structures of the cranidium. Figure 1 is a diagram of the cranidium of a typical trilobite labeled to show the measurements used in this paper. Because of the varied curvatures in trilobites all measurements are made in a horizontal plane as follows:

1. Length of glabella—distance along axial line from junction of glabella and occipital furrow to junction of front of glabella and dorsal furrow.
2. Width of glabella—width at midpoint of glabella between junction of glabella and dorsal furrow on each side measured at right angle to axial line.
3. Width of fixed cheek—greatest width of fixed cheek measured from edge of glabella to outermost extremity of palpebral lobe at right angle to axial line.
4. Width of brim—distance along axial line from front of glabella to rear edge of border, thus including the marginal furrow.
5. Width of border—distance along axial line from posterior edge of border to front of cranidium.
6. Width of occipital ring—distance along axial line from posterior edge of ring to posterior edge of glabella.
7. Length of cranidium—distance along axial line from posterior edge of cranidium to front edge of cranidium, or a composite of measurements 1, 4, 5 and 6.

Criticism of this method of measurement largely centers around the inclusion of the furrows in certain measurements such as those of the dorsal furrow in the width of the fixed cheek and the occipital furrow in the width of the occipital ring. However, the furrows vary in width depending upon the preservation of the specimen, and extreme variation is found between exfoliated and non-exfoliated tests. Thus, by including the furrows in the measurement of the parts, furrow variation will have the least effect upon the ratios established for quantitative study. Further, this method allows the whole, i.e., the length of the cranidium, to be equal to the sum of its parts, i.e., length of glabella, width of brim, border and occipital ring.

During the course of this investigation I found a complete disregard on the part of some paleontologists of certain considerations that seem fundamental to me. Although these facts seem obvious, much of the restudy of described species that was necessary during the preparation of this paper resulted from the following mistakes.

Investigators have frequently established

new species on the basis of size, where minor variations existed between small (immature) and large (mature) specimens from the same bed. This error usually can be overcome by detailed collecting in order to obtain a complete moult sequence of small to large specimens. However, if the tests are sorted as a result of wave and current action most specimens in a given bed will be of the same relative size and weight. Under these circumstances variations may exist between specimens from different localities as a result of concentrations of moults of one growth stage in one area, and of another growth stage of the same species in a different area. Such concentrations of similar sized individuals should suggest caution in interpretation.

Variations in lithology have also resulted in errors in interpretation. Lithologic variations commonly produce differences in preservation of certain features of the trilobite carapace such as distinctness of glabellar and dorsal furrows, angular position of the fixed cheek, convexity and shape of the brim and border, etc. This may be readily observed by comparing similar species preserved in limestone and sandstone matrices, but differences also exist between fossils in fine-grained and coarse-grained sandstones, and even between fossils preserved in limestones of different textures.

Trilobites present another problem not encountered among most other groups of fossil organisms. Probably the majority of fossilized parts of the trilobite carapace were moults. These softened, lime-impregnated chitinous tests may have been subject to (1) transportation by waves and currents; (2) shrinking, curling or abrasion as a result

TABLE 1. RANGES OF GENERA IN HONEY CREEK FORMATION. (A) ABUNDANT, (R) RARE, (M) MODERATELY NUMEROUS

Genus	*Elvinia* Zone	*Ptycho-pleurites* Zone	*Conaspis* Zone	
			Eoorthis Subzone	*Taenicephalus* Subzone
Billingsella (A)			***	**********
Bemaspis (R)				***
Bernia (M)			**********	
Eoorthis (A)			**********	
Idahoia? (R)				****
Meeria (M)				*****
Orygmaspis (M)			**	*****
Parabolinoides (A)			**********	
Pseudagnostus (A)				**********
Taenicephalus (A)				**********
Wilbernia (R)				*****
Irvingella (A)	**********	********		
Kiowaia (M)		********		
Ptychopleurites (M)		********		
Apachia (M)	**********			
Bernicella (R)	*****			
Berkeia (M)	*********			
Burnetia (M)	**********			
Camaraspis (A)	**********			
Camaraspoides (R)	******			
Deckera (M)	**********			
Dellea (A)	**********			
Dokimocephalus (A)	**********			
Elvinia (A)	**********			
Kindbladia (A)	**********			
Plataspella (A)	**********			
Pterocephalia (A)	**********			

of temporary exposure to air; or (3) flattening upon burial and compaction of the sediments. The influence of any one or combination of these factors will result in changes in the appearance of the fossil specimen which may lead to fundamental errors in interpretation.

The fossils collected from the Honey Creek formation reveal the presence of three fossil zones recognized in Upper Cambrian strata throughout the central United States. Although the actual thickness of the three faunal zones varies with changes in the thickness of the formation throughout the areas of outcrop, the relative vertical spread of the faunas is quite constant. The lowermost zone contains the *Elvinia* fauna, which extends about two-thirds up into the formation; the intermediate zone containing the *Ptychopleurites* fauna is never greater than five feet in thickness; and the *Conaspis* fauna is found in the upper one-third of the formation.

The *Elvinia* zone is extremely fossiliferous, containing a large number of individuals representing fourteen trilobite genera. *Kindbladia*, *Plataspella*, *Bernicella* n. gen. and *Dellea* appear in the lowermost beds, with *Camaraspis*, *Dokimocephalus*, *Irvingella*, *Elvinia*, *Deckera* n. gen., *Apachia* n. gen., *Burnetia*, *Berkeia*, *Camaraspoides* n. gen., and *Pterocephalia* occurring in succeeding beds. The relative ranges of the trilobite genera are shown in Table 1. The phosphatic brachiopods *Acrotreta*, *Lingulella*, *Lingulepis* and *Linnarssonella* are abundant in this zone.

Only *Irvingella* of the *Elvinia* fauna continues into the *Ptychopleurites* zone, where it constitutes by far the most abundant form. At the top of the *Ptychopleurites* zone, cranidia of *Irvingella* form a coquina about three inches thick which is immediately overlain in most areas by an *Eoorthis* coquina constituting the base of the overlying *Conaspis* zone. Genera confined to the *Ptychopleurites* zone are *Kiowaia* n. gen. and *Ptychopleurites*.

The *Conaspis* zone is divisible into two subzones, the *Eoorthis* subzone and the *Taenicephalus* subzone. The former contains *Eoorthis remnichia*, *E. indianola*, *E. wichitaensis*, *Billingsella coloradoensis*, *Bernia* n. gen., and *Parabolinoides* n. gen. *Orygmaspis* appears at the very top of this zone.

The *Taenicephalus* subzone is characterized by *Taenicephalus*, which is extremely abundant. Other genera are *Bemaspis* n. gen., *Orygmaspis*, *Meeria*, n. gen., *Wilbernia*, *Idahoia*? *Pseudagnostus*, *Billingsella* and *Huenella*. The genus *Conaspis* has not been found in the Honey Creek formation, although other forms characteristic of the

---

EXPLANATION OF PLATE 68

FIGS. *1–9—Camaraspoides berkeyi* (Resser). *1*, Hypotype; cranidium, ×2, O. G. M. 105-16F-156b, loc. 6. *2*, *3*, Hypotype; dorsal and profile views of nearly complete cranidium, ×5, O. G. M. 105-16F-155, loc. 6. *4*, Hypotype; cranidium, ×4, O. G. M. 105-16F-156a, loc. 6. *5*, *6*, Hypotype, dorsal and profile views of pygidium, ×4, O. G. M. 105-16F-97, loc. 6. *7*, Holotype; cranidium designated by Resser (illustrated by Berkey (1898) on Pl. 20, figs. 1 and 2, and Pl. 21, fig. 5), ×2, Columbia Univ. No. 22283. *8*, Hypotype; cranidium, one of Berkey's specimens, ×2, Columbia Univ. No. 22284. *9*, Paratype; pygidium illustrated originally by Berkey as *Agraulos convexus* "probably" on Pl. 20, fig. 11, ×2, unnumbered from Columbia Univ. Coll. (p. 349)

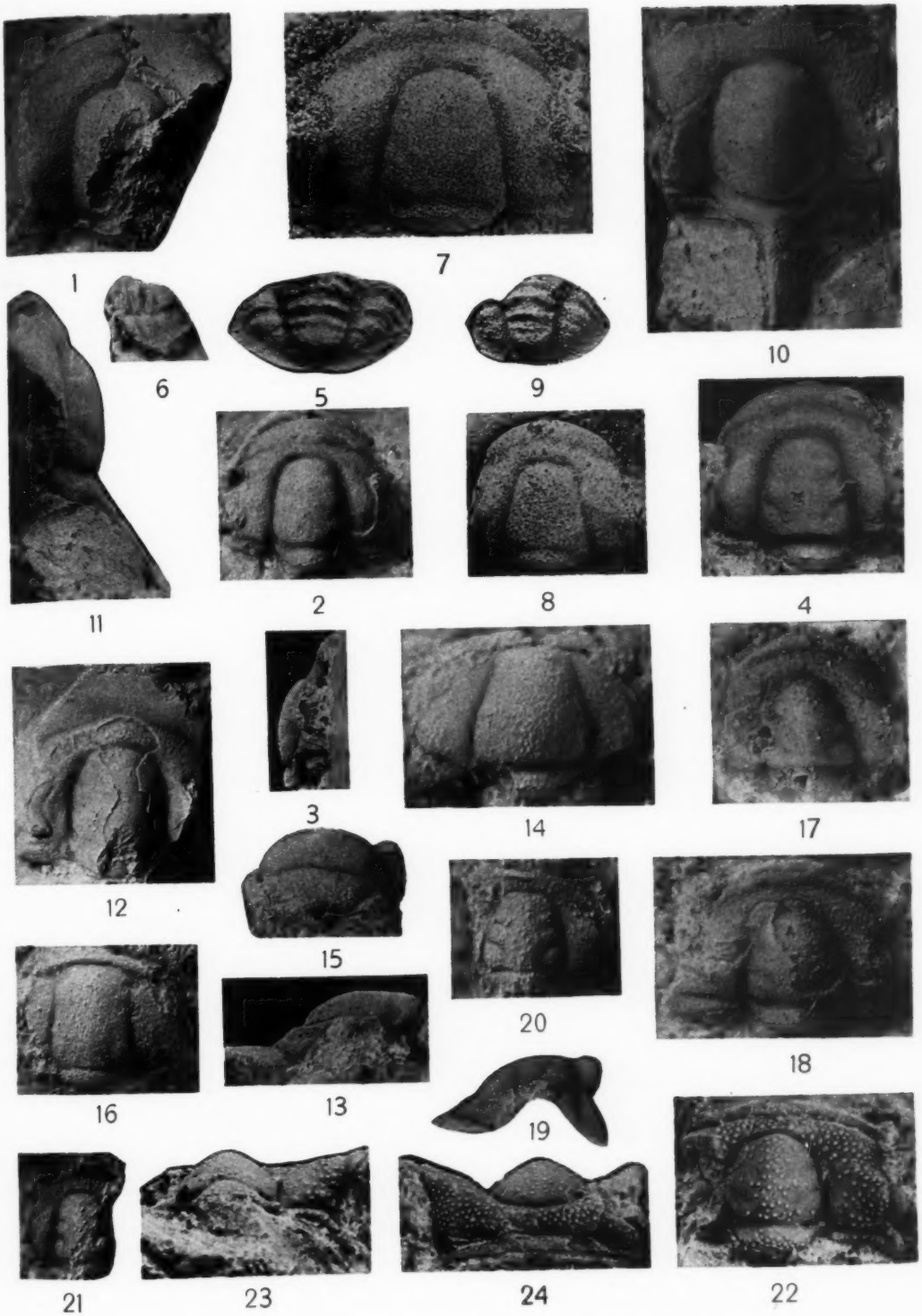
10–13—Plataspella anatina (Resser). *10*, *11*, Hypotype; dorsal and profile views of cranidium showing spine, ×2, O. G. M. 105-16F-7, loc. 12. *12*, *13*, Hypotype; dorsal and profile views of cranidium, ×2, O. G. M. 105-16F-8, loc. 12. (p. 355)

14–16—Bernicella minuta Frederickson, n. sp. *14*, *15*, Holotype; dorsal and profile views of cranidium, ×9, O. G. M. 105-16F-162a, loc. 8. *16*, Paratype; cranidium, ×9, O. G. M. 105-16F-162b, loc. 8. (p. 348)

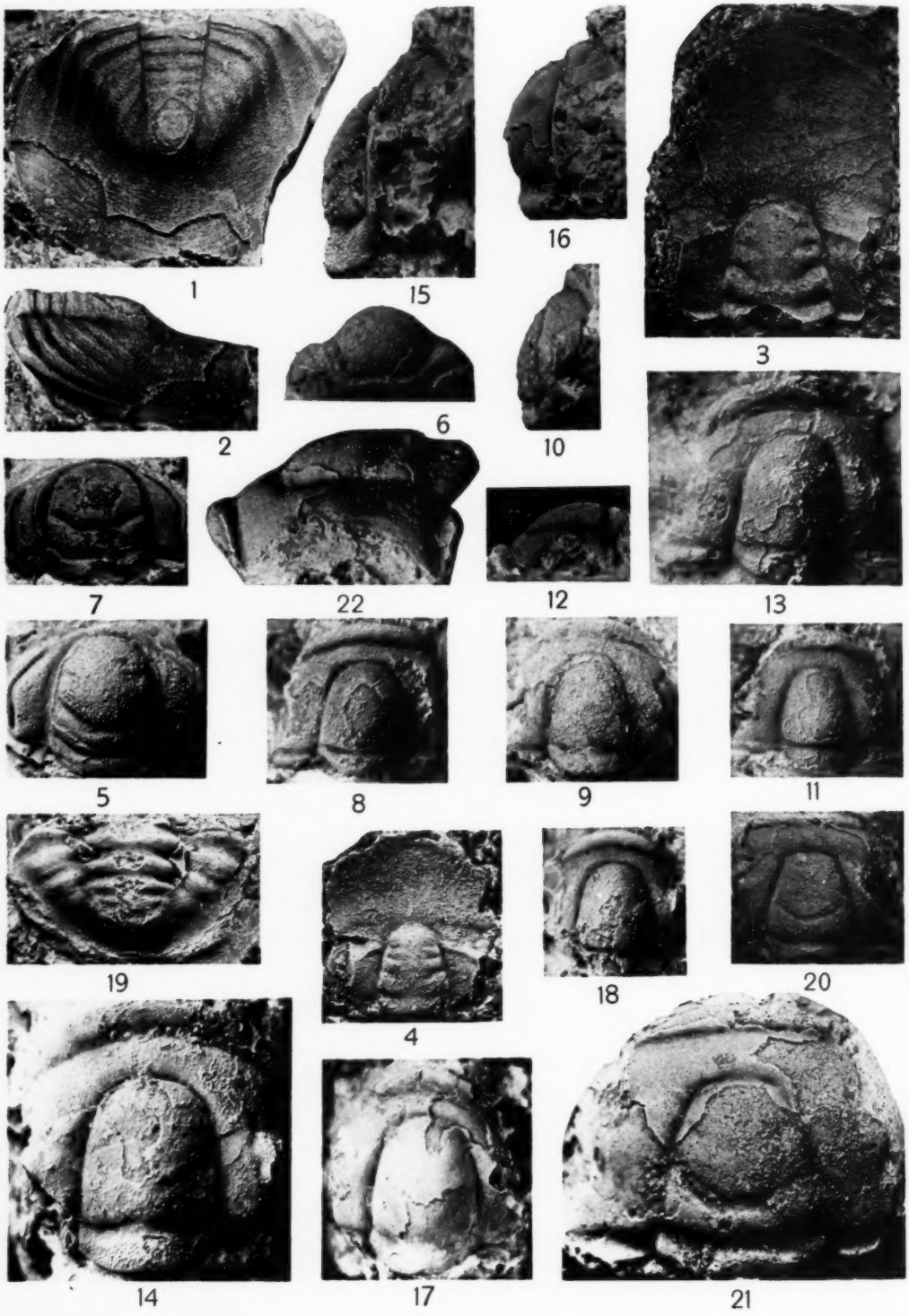
17–19—Berkeia lata Frederickson, n. sp. *18*, *19*, Holotype; dorsal and profile views of cranidium, ×6, O. G. M. 105-16F-163a, loc. 9. *17*, Paratype; cranidium, ×6, O. G. M. 105-16F-163b, loc. 9. (p. 347)

20–21—Berkeia sp. 20, cranidium, ×9, O. G. M. 105-16F-98, loc. 6. *21*, cranidium, ×9, O. G. M. 105-16F-160, loc. 6. (p. 347)

22–24—Deckera aldenensis Frederickson, n. sp. Holotype; dorsal, posterior and anterior views of cranidium, ×4, O. G. M. 105-16F-158, loc. 6. (p. 350)



Frederickson, Upper Cambrian Trilobite Fauna



Frederickson, Upper Cambrian Trilobite Fauna

Conaspis zone fauna of the Upper Mississippi Valley occur abundantly.

The list of trilobite species from the three zones as recognized in the Honey Creek formation is as follows:

CONASPIS ZONE

Taenicephalus subzone

Bemaspis gouldi Frederickson, n. sp.
Idahoia ? longa Frederickson, n. sp.
Meeria lirae Frederickson, n. sp.
Orygmaspis llanoensis (Walcott)
Orygmaspis firma Frederickson, n. sp.
Pseudagnostus josepha (Hall)
Taenicephalus wichitaensis Resser
Wilbernia pero (Walcott)
Wilbernia expansa Frederickson, n. sp.

Eoorthis subzone

Bernia obtusa Frederickson, sn. sp.
Orygmaspis firms Frederickson, n. sp.
Parabolinoides hebe Frederickson, n. sp.
Parabolinoides contractus Frederickson, n. sp.

PTYCHOPLEURITES ZONE

Irvingella major Ulrich and Resser
Kiowaia timberensis Frederickson, n. sp.
Ptychopleurites amplooculatus Frederickson

ELVINIA ZONE

Apachia trigonis Frederickson, n. sp.
Bernicella minuta Frederickson, n. sp.
Berkeia lata Frederickson, n. sp.
Berkeia sp.
Burnetia urania (Walcott)
Burnetia exilis Resser
Camaraspis convexa (Whitfield)
Camaraspis plana Frederickson
Camaraspis parabola Frederickson
Camaraspoides berkeyi (Resser)
Deckera aldenensis Frederickson, n. sp.
Dellea juvenalis Frederickson, n. sp.
Dellea butlerensis Frederickson, n. sp.
Dokimocephalus curta (Resser)
Dokimocephalus intermedia (Resser)
Elvinia roemeri (Shumard)
Irvingella major Ulrich and Resser
Kindbladia wichitaensis (Resser)
Plataspella anatina (Resser)
Pterocephalia sanctisabae Roemer

All specimens are in the Oklahoma Geological Museum to which the letters O. G. M. preceding the fossil number refer. Terms used in the descriptions and the sequence for the description follow the outline proposed by Howell et al. (1947).

The locality numbers apply to the following areas from which the specimens were collected:

WICHITA MOUNTAINS

Locality 6. N½ Sec. 24, T. 4N., R. 13W. Isolated hill one-third mile west of main road through Blue Creek Canyon. Southwest side of Blue Creek Canyon anticline. Honey Creek formation overlapping Reagan sandstone and resting on pre-Cambrian igneous rock. Comanche County, Okla.

Locality 7. SW¼ Sec. 17, T. 4N., R. 12W. Abandoned oolitic hematite paint pigment mine on northeast side Blue Creek Canyon anticline. Comanche County, Okla.

Locality 8. NE¼ NE¼ Sec. 2, T. 4N., R. 13W. at end of old W.P.A. Quarry road, Blue Creek Canyon. Comanche County, Okla.

Locality 9. SW¼ Sec. 26, T. 6N., R. 14W. Kindblade Ranch section, three miles west of U. S. Highway 54. Large limestone outcrop with Honey Creek overlapping Reagan sandstone and resting

---

EXPLANATION OF PLATE 69

FIGS. *1–4*—*Pterocephalia sanctisabae* Roemer. *1, 2*, Hypotype; pygidium, dorsal and profile views, ×2, O. G. M. 105-16F-61, loc. 13. *3*, Hypotype; cranidium showing inosculating lines on brim, ×2, O. G. M. 105-16F-54, loc. 11. *4*, Hypotype; small cranidium, ×2, O. G. M. 105-16F-56, loc. 11. (p. 355)

5–7—*Irvingella major* Ulrich and Resser. *5, 6*, Hypotype; dorsal and anterior views of cranidium, ×2, O. G. M. 105-16F-48. *7*, Hypotype; cranidium, ×2, O. G. M. 105-16F-49, loc. 14. (p. 353)

8–15—*Dellea juvenalis* Frederickson, n. sp. *11, 12*, Holotype; dorsal and profile views of cranidium, ×5, O. G. M. 105-16F-29, loc. 8. *8*, Paratype; cranidium, ×5, O. G. M. 105-16F-31, loc. 9. *9, 10*, Paratype; cranidium, dorsal and profile views, ×2½, O. G. M. 105-16F-20, loc. 11. *13*, Paratype; cranidium, ×4, O. G. M. 105-16F-164a, loc. 9. *14, 15*, Paratype; dorsal and profile view of cranidium showing granules, ×4, O. G. M. 105-16F-164b, loc. 9. (p. 351)

16–18—*Dellea butlerensis* Frederickson, n. sp. *16, 17*, Holotype; profile and dorsal view of cranidium, ×3, O. G. M. 105-16F-165a, loc. 9. *18*, Paratype; small cranidium, ×4, O. G. M. 105-16F-165b, loc. 8. (p. 351)

19–21—*Elvinia roemeri* (Shumard). *19*, Hypotype; pygidium, ×2, O. G. M. 105-16F-64, loc. 12. *20*. Hypotype; small cranidium, ×2, O. G. M. 105-16F-68, loc. 8. *21, 22*, Hypotypes; dorsal and profile views of large cranidium showing massive, coarser characteristics developed in maturity, ×2, O. G. M. 105-16F-65, loc. 13. (p. 352)

on pre-Cambrian porphyry at northwest edge. Kiowa County, Okla.

Locality 10. NW¼ Sec. 16, T. 6N., R. 14W. Small limestone hill resting on pre-Cambrian porphyry and forming northernmost outcrop of Honey Creek in Wichita Mountains. Kiowa County, Okla.

ARBUCKLE MOUNTAINS

Locality 11. Southeast corner SE¼ Sec. 4, T. 1S., R. 1W. Reagan, Honey Creek and lower Fort Sill formations exposed at end of section line road between Secs. 3 and 4. Northwest edge West Timbered Hills, Murray County, Okla.

Locality 12. NE¼ NW¼ Sec. 9, T. 1S., R. 1W., one-half mile southeast of Loc. 11 along strike.

Locality 13. SW¼ SE¼ Sec. 4, T. 1S., R. 1W., one-quarter mile west of Loc. 11 along strike at farthest north extension of igneous rocks.

Locality 14. SE¼ SE¼ Sec. 23, T. 1S., R. 1W. South edge West Timbered Hills along northeast trending intermittent stream valley. No roads in this area, only ranch trails. Murray County, Okla.

Locality 15. NW¼ NW¼ Sec. 1, T. 2S., R. 1E. Type section of Honey Creek formation on southwest edge of East Timbered Hills south of Honey Creek which flows across the strike of the formation. Murray County, Okla.

Locality 16. NE¼ SW¼ Sec. 1, T. 2S., R. 1E., one-half mile southeast of Loc. 15 along strike.

ACKNOWLEDGEMENTS

Grants from the Faculty Research fund of the University of Oklahoma made possible a visit to the National Museum, Washington, D. C. for a comparison of type specimens, and also defrayed the cost of equipment and photographic supplies. I wish to thank Prof. W. C. Bell of the University of Minnesota and Dr. Christina Lochman Balk of Chicago for their many helpful suggestions and for critical reviewing of the manuscript. Mr. James L. Wilson of Yale University furnished me with photographs and plaster casts of various Upper Cambrian trilobites, and information concerning contemporary forms in the Texas section. Mr. Kermit Butler assisted in photographing the specimens.

SYSTEMATIC DESCRIPTIONS

ELVINIA ZONE FAUNA

Genus APACHIA Frederickson, n. gen.

Cranidium slightly tapering anteriorly, highly convex; glabella subconical, broadly rounded at front, steep-sided, posterior rising steeply from occipital furrow and descending in convex curve to dorsal furrow anteriorly; no glabellar furrows; dorsal and occipital furrows deeply incised, occipital ring convex. Brim convex, slightly wider than convex, laterally tapering border. Fixed cheeks flat, less than one-half width of glabella at midpoint; palpebral lobes narrow, opposite midpoint of glabella. Posterior limbs broadly triangular, very convex; marginal furrow deep.

Genotype.—*Apachia trigonis* Frederickson, n. sp.

Remarks.—The new genus *Apachia* is based on one species of which numerous cranidia have been found.

APACHIA TRIGONIS Frederickson, n. sp.
Plate 70, figures 14–17

Cranidium highly convex; glabella tumid, rounded conical, steep-sided; posterior portion rising steeply above occipital furrow and then descending anteriorly in smooth convex curve to dorsal furrow, no glabellar furrows; dorsal furrow deeply impressed at sides, fainter around front of glabella; occipital furrow deep; occipital ring convex, of equal width. Brim convex, descending from dorsal furrow along axial line at nearly same angle as front of glabella; marginal furrow narrow, deep, slightly curved forward; border nearly equal to brim in width, convex, rising at 45° angle from V-shaped marginal furrow. Fixed cheek flat, equal to slightly less than one-half width of glabella at midpoint; palpebral lobes narrow, elongate, located opposite midpoint of glabella. Posterior limbs triangular, dipping away from glabella in steep convex curve; marginal furrow deep.

Facial suture cuts anterior margin on line with side of glabella, trends laterally around marginal furrow forming crescentic border, then straight backward to curve around narrow palpebral lobes and swing outward and downward in smooth concave curve to cut posterior margin. Outer surface of test smooth.

Pygidium unknown.

Occurrence.—Honey Creek formation, Arbuckle and Wichita Mountains, localities 8, 11, 12 and 13.

Holotype.—Cranidium, O. G. M. 105-16F-167a, paratype, cranidium, O. G. M. 105-16F-167b, locality 8.

Genus BERKEIA Resser, 1937

BERKEIA LATA Frederickson, n. sp.

Plate 68, figures 17–19

Cranidium broad and short; glabella evenly convex, rounded conical; length slightly less than greatest width; three pairs of glabellar furrows, last pair curved obliquely; dorsal furrow impressed; occipital furrow deep, curved forward laterally; occipital ring convex, widest at center. Brim dipping forward, flatly convex in front of glabella, convexity increasing laterally; marginal furrow bowed forward, shallow; border nearly equal to brim along axial line, flatly convex, slightly raised above marginal furrow. Fixed cheek convex, approximately equal to glabellar width at midpoint; palpebral lobes unknown. Posterior limbs four-fifths length of occipital ring, convex; marginal furrow incised. Surface of test smooth.

Course of facial suture and character of pygidium unknown.

Remarks.—*Berkeia lata*, n. sp. resembles *Berkeia saratogensis* Resser in general appearance, but differs specifically as follows. In *B. lata* the cranidium is broad; the ratio of length of glabella to cranidium width across the posterior limbs is .60 on the holotype cranidium. This ratio for the holotype and paratypes of *B. saratogensis* is not less than .70, indicating the narrower appearance of the latter. *B. lata* also has a nearly continuously sloping brim and border and the brim and border are nearly equal in width, whereas in *B. saratogensis* the brim continues the convexity and slope of the glabella, and the brim is about twice as wide as the upsloping border. Compared with *Berkeia typica* Resser, the genotype, *B. lata* has a less steeply sloping brim, a wider, less upturned border, and much flatter fixed cheeks.

Occurrence.—Honey Creek formation, (*Elvinia* zone), Arbuckle and Wichita Mountains, localities 8, 9, 12 and 13.

Holotype.—Cranidium, O. G. M. 105-16F-163a; paratype, cranidium, O. G. M. 105-16F-163b, locality 9.

BERKEIA SP.

Plate 68, figures 20, 21

These small forms are rare in the Honey Creek formation and have been found only at locality 6 in the Wichita Mountains in association with *Camaraspoides* and *Deckera*.

Although parts of seven cranidia were found, the material is so fragmentary that I consider it inadvisable to erect a new species on the available specimens. The largest cranidium measures 3 mm. in length. The Oklahoma forms are similar to *Berkeia typica* Resser but differ in having a less steeply sloping brim and a blunter anterior portion of the glabella. It is possible that these specimens may be young individuals of *B. lata*. However, inasmuch as I have found them only at locality 6, and since no similar forms have been found associated with *B. lata*, I did not feel justified in assigning them to that species.

Occurrence.—Honey Creek formation, (*Elvinia* zone), Wichita Mountains.

Figured Specimens.—Cranidia, O. G. M. 105-16F-98, O. G. M. 105-16F-160, locality 6.

Genus BERNICELLA Frederickson, n. gen.

Cranidium wider than long; glabella convex, straight-sided or tapering anteriorly to blunt termination; no glabellar furrows; dorsal furrow well marked, converges with marginal furrow; occipital furrow deep, occipital ring widest at center. Brim present only at sides because of confluence of marginal and dorsal furrows; border convex, narrow. Fixed cheeks wide, convex and downsloping; palpebral lobes anterior to glabellar midpoint, facing antero-laterally. Posterior limbs broad; marginal furrow not known.

Genotype.—*Bernicella minuta* Frederickson, n. sp.

Remarks.—The new genus *Bernicella* is based upon two small cranidia from the base of the *Elvinia* zone. The holotype cranidium measures 2.7 mm. in length and the paratype 2 mm. in length. *Bernicella* resembles *Cheilocephalus* Berkey in the general appearance of the cranidium, but differs in the bar-like character of the border, the larger fixed cheeks and the anteriorly facing palpebral lobes. The small size of *Bernicella* and the resemblance to *Cheilocephalus* suggests the possibility that these may be young individuals of *Cheilocephalus* but the absence of this latter genus from the Oklahoma collections makes this

supposition highly conjectural in the light of our present knowledge of Berkey's genus.

BERNICELLA MINUTA Frederickson, n. sp.
Plate 68, figures 14–16

Cranidium wide and short, length equal to two-thirds width across posterior limbs. Glabella quite convex, straight-sided in smallest specimen, but in largest specimen glabella is straight-sided in posterior two-fifths and then abruptly converges forward; anterior of glabella blunt; dorsal furrow impressed at sides, becoming fainter at anterior corners of glabella just before converging with marginal furrow; occipital ring widest at center, convex; occipital furrow deep. Brim present only at sides; marginal furrow well marked, curved slightly, intercepts dorsal furrow; border raised, convex, very narrow, cord-like. Fixed cheeks over one-half width of glabella at midpoint, convex, down-sloping; palpebral lobes located anterior to middle of glabella, narrow, facing antero-laterally; palpebral furrow faint. Posterior limbs broad. Free cheek unknown.

Facial suture cuts border on line with middle of fixed cheek, trends slightly outward and backward to palpebral lobe around which it curves and then swings backward in convex curve to posterior margin.

Occurrence.—Honey Creek formation, (*Elvinia* zone), Wichita Mountains, locality 8.

Holotype.—Cranidium, O. G. M. 105-16F-162a; paratype, cranidium, O. G. M. 105-16F-162b, locality 8.

Genus BURNETIA Walcott, 1924
BURNETIA URANIA (Walcott)
Plate 70, figures 12, 13

Ptychoparia (?) *urania* WALCOTT, 1890, Proc. U. S. Nat. Mus., p. 274, pl. 21, figs. 10, 11.
Burnetia urania WALCOTT, 1924, Smithsonian Misc. Coll., vol. 75, no. 2, p. 54, pl. 10, fig. 2.
Burnetia urania WALCOTT, 1925, Smithsonian Misc. Coll., vol. 75, no. 3, p. 77, pl. 17, figs. 1–3.
Burnetia urania (Walcott) SHIMER and SHROCK, 1944, Index Fossils of N. Amer., p. 621, pl. 263, figs. 25, 26.
Burnetia urania (Walcott) WILSON, 1949, Jour. Paleontology, vol. 23, no. 1, pp. 32–33, pl. 9, figs 3, 9, 10.

Remarks.—Several cranidia of this species have been found and they show the flaring character of the border, suggested by Walcott but not shown very well in the published photographs of this species.

Occurrence.—Honey Creek formation, (*Elvinia* zone), Arbuckle and Wichita Mountains, localities 8, 9, and 11.

Hypotype.—Cranidium, O. G. M. 105-16F-27, locality 11.

BURNETIA EXILIS Resser
Plate 70, figures 9–11

Burnetia exilis RESSER, 1942, Smithsonian Misc. Coll., vol. 103, no. 5, pp. 81, 82, pl. 17, figs. 23–27.
Burnetia ectypa RESSER, 1942, idem., p. 82, pl. 17, figs. 30, 31.

Remarks.—This species is very abundant in the Honey Creek formation. As compared with *B. urania*, *B. exilis* is characterized by the greatly decreased axial convexity of the glabella. Whereas in *B. urania* the glabella is bulbous and descends steeply to the anterior dorsal furrow, even appearing to slightly overhang the furrow; in *B. exilis* the glabella descends in a smooth gentle convex curve. In addition, the brim immediately anterior to the glabella in *B. urania* is almost non-existent due to the close confluence of the marginal and dorsal furrow, but in *B. exilis* the brim is plainly observable as a narrow, convex ridge.

A comparison of the holotype of *Burnetia ectypa* Resser with *B. exilis* indicated no specific differences between these two species. The glabella of *B. ectypa* was slightly less pronounced than in *B. exilis*, but the specimen was larger than any of Resser's collection of *B. exilis* and this may well account for individual differences. In his description of *B. ectypa*, Resser states that the "glabella . . . has the rear pair of glabellar furrows of normal development and very shallow indentations indicating the second pair," (actually first pair of the specimen). This shallow character of the first pair of furrows is due entirely to exfoliation of that portion of the glabella.

Occurrence.—Honey Creek formation, (*Elvinia* zone), Arbuckle and Wichita Mountains, localities 8, 9, 10, 11, 12, and 13.

Hypotype.—Cranidia, O. G. M. 105-16F-26, O. G. M. 105-16F-28, locality 12.

Genus CAMARASPOIDES Frederickson, n. gen.

Cranidium hemispherical; glabella subconical, rounded anteriorly, convex and descending abruptly at margins to broadly impressed dorsal furrow; three pairs of faint glabellar furrows, first pair straight, other two pairs oblique; occipital furrow wide and curving posteriorly at sides; occipital ring convex with small median node. Brim wider than border, convex; marginal furrow wide on exfoliated specimens, nearly indiscernible on test surface; border convex, crescentic. Fixed cheeks slightly more than one-half width of glabella at midpoint, horizontal; palpebral lobes large, behind glabellar midpoint. Posterior limbs triangular, marginal furrow impressed.

Pygidium ovoid, axis short, convex, tapering very slightly to a rounded termination, rear portion sloping and blending into the raised central posterior portion of border; four axial segments; pleural platforms sloping laterally, flatly convex, marked by three interpleural grooves; border narrow, concave.

Genotype.—Camaraspoides berkeyi (Resser).

Remarks.—The new genus *Camaraspoides* is based upon certain of Berkey's specimens from the St. Croix Dalles area of Minnesota and Wisconsin, which he originally referred to *Agraulos convexus* Whitfield and which Resser subsequently designated as *Modocia berkeyi*. The specimens included under this species, however, cannot be referred to the genus *Modocia*, but show the following fundamental differences. *Camaraspoides* has a slightly tapering quadrate glabella with three pairs of glabellar furrows; the border is depressed convex and the fixed cheeks are slightly more than one-half the width of the glabella at the midpoint. In *Modocia*, however, the glabella is rounded conical with nearly indiscernible furrows, the border is narrow, convex and upraised, and the fixed cheeks are slightly less than one-half the width of the glabella at the midpoint. *Camaraspoides* does show a family relationship to *Camaraspis* Ulrich and Resser. The former may be readily distinguished, however, by the deeper dorsal furrow, presence of glabellar furrows, the convex border, and especially by the furrowed pygidium as contrasted to the smooth, unfurrowed pygidium of *Camaraspis*.

Six cranidia and a pygidium from the Honey Creek formation are referred to *Camaraspoides berkeyi*. These are well preserved limestone specimens, although all but a portion of one specimen are internal molds. The specimen which retains a portion of the test indicates that cranidial markings such as the marginal furrows, dorsal furrow, glabellar furrows, etc. were much less impressed on the surface of the test than on the exfoliated internal mold.

In order to eliminate confusion the holotype cranidium, paratype pygidium, and a hypotype cranidium of Berkey's original specimens which were designated *Modocia berkeyi* by Resser are illustrated for comparison with the Oklahoma forms. I am indebted to Dr. W. C. Bell of the University of Minnesota for these photographs of Berkey's specimens.

CAMARASPOIDES BERKEYI (Resser)
Plate 68, figures 1–9

Agraulos convexus Whitfield BERKEY, 1898, Am. Geologist, vol. 21, p. 288, pl. 20, figs. 9–11; pl. 21, figs. 3, 7.

Agraulos convexus Whitfield var. A. BERKEY, 1898, idem., p. 288, pl. 20, figs. 1, 2; pl. 21, fig. 5, (the holotype designated by Resser).

Modocia berkeyi RESSER, 1935, Smithsonian Misc. Coll., vol. 93, no. 5, p. 42.

Cranidium somewhat hemispherical, slightly wider across eyes than long; glabella sub-conical, rounded anteriorly, convex and descending rather abruptly to dorsal furrow which is broad and impressed; three pairs of glabellar furrows, faint and not extending across glabella, first pair straight, second and third pairs curving posteriorly; occipital furrow wide, occipital ring widest at center, sharply curved posteriorly with small median node. Brim wider than border, convex; marginal furrow wide, shallow on exfoliated specimens, nearly indiscernible on surface of test; border convex, crescentic. Fixed cheeks slightly more than one-half width of glabella on midline, horizontal, convex; palpebral lobes large, slightly posterior to midline of glabella. Posterior limbs short, triangular, with well impressed anteriorly curved marginal furrow.

Free cheek unknown.

Facial suture cuts frontal margin near center, trends outward widely around margin of border, then bends inwards to palpebral lobe around which it curves and bends outward and backward in a gentle curve cutting the posterior border within the genal angle.

Pygidium ovoid, axis short, convex, tapering very slightly to a rounded termination, rear portion sloping and blending into the raised central posterior portion of border; four axial segments; pleural platforms sloping laterally, flatly convex, marked by three interpleural grooves; border narrow, concave.

Occurrence.—Honey Creek formation, (*Elvinia* zone) Wichita Mountains, locality 6.

Hypotypes.—Cranidia, O. G. M. 105-16F-155, 156a–b, 157; pygidium O. G. M. 105-16F-97, locality 6.

Genus DECKERA Frederickson, n. gen.

Cranidium rectangular; glabella short, convex, rounded conical; two pairs of faint glabellar furrows; occipital furrow narrow, impressed at sides, occipital ring widest at center. Brim steeply convex lateral to glabella, anteriorly may be convex or flat, the latter giving impression of median boss as in *D. vigilans;* border convex, slightly tapering laterally, separated from brim by deep, narrow marginal furrow. Fixed cheeks nearly equal to width of glabella, upsloping; palpebral lobes short but wide, hemispheric, located posterior to glabella midpoint; anteriorly trending ocular ridge formed by forward deflection of fixed cheek toward brim. Posterior limbs convex, about four-fifths length occipital ring, strongly curved downward from plane of head and with narrow rounded extremities; deep marginal furrow.

Facial suture appears to cut anterior margin on line with dorsal furrow, curves outward and upward to palpebral lobe around which it curves parabolically, thence it cuts inward to a position opposite the occipital furrow and then outward in a smooth concave curve along posterior limb to margin. Outer surface of test granulose.

Free cheeks, thorax and pygidium unknown.

Remarks.—Deckera is based on two species, one occurring rather abundantly in the Wichita Mountain area; the other described as *Acrocephalites vigilans* Walcott and Resser (1924, pp. 10, 11) from Novaya Zemlya. However, J. L. Wilson (personal communication, 1947) has reported finding forms belonging to this genus in Texas and in the Ore Hill member in Pennsylvania, so that future studies will doubtless greatly increase the geographic range.

Genotype.—Deckera aldenensis Frederickson, n. sp.

DECKERA ALDENENSIS Frederickson, n. sp.
Plate 68, figures 22–24

Cranidium short and broad; glabella short, wide, tumid, cuneiform, rounded in front; two pairs of faint glabellar furrows; occipital furrow narrow, more deeply impressed at sides than over center of glabella; occipital ring convex, widest at center; dorsal furrow strong. Brim twice width of border, convex, dipping steeply and abruptly away from glabella; border convex, cord-like, slightly wider in center than at sides; marginal furrow narrow, deep, slightly bowed. Fixed cheek nearly equals width of glabella, rising at about 25° angle from dorsal furrow; palpebral lobes hemispheric, situated posterior to midpoint of glabella and elevated on convex, stalk-like fixed cheek high above glabella; ocular ridge trending anteriorly at 30° angle. Posterior limbs convex, strongly curved away and downward from plane of head and with narrow, rounded extremities; deep marginal furrow. Free cheek not known.

Facial suture cuts anterior margin on line with dorsal furrow, curves outward and around transverse furrow and diverges outward and upward to palpebral lobe, around which it curves, then trends inward and then outward in smooth concave curve along posterior limb to posterior margin.

Outer surface of test covered with scattered granules, markedly absent in all furrows of cranidium, and on glabellar slopes.

Remarks.—This small species has been found only in the Wichita Mountains. Cranidium of largest, most complete specimen 6 mm. long, 10 mm. wide across palpebral lobes.

Occurrence.—Upper Cambrian, Honey

Creek formation, (*Elvinia* zone), localities 6 and 9, Wichita Mountains.

Holotype.—Cranidium, O. G. M. 105-16F-158. locality 6.

DECKERA VIGILANS (Walcott and Resser)

Acrocephalites vigilans WALCOTT and RESSER, 1924, Report of the Scientific Results of the Norwegian Expedition to Novaya Zemlya, 1921, no. 24, pp. 10–11, pl. 2, figs. 38–40.

Comparison of the plastotype of *Acrocephalites vigilans* in the U. S. National Museum, with specimens of *Deckera aldenensis*, indicates that they belong to the same genus. The main difference is the apparent median boss in *D. vigilans* which results from a flattening of the brim immediately anterior to the glabella with accompanying steep downcurving of the anterior lateral portions of the brim and border. In *D. aldenensis*, the entire brim is steeply convex. Further, although the holotype illustrated by Walcott and Resser shows a median cranidial spine, this is obviously drawn in on the retouched photograph, as the text of their description plainly states that "neither of the cranidia has the frontal margin preserved so that it is impossible to state whether or not there was a median spine . . . ."

Deckera vigilans differs from *Acrocephalites stenometopus* Wallerius in the much broader and more markedly upsloping fixed cheeks, the much smaller palpebral lobes, the shorter, rounder glabella, and the absence of the median boss and cranidial spine.

Genus DELLEA Wilson, 1949

DELLEA JUVENALIS Frederickson, n. sp.
Plate 69, figures 8–15

Cranidium wider across posterior limbs than long; glabella convex, with greatest convexity near occipital furrow, broadly conical, slightly blunt anteriorly; two pairs of faint glabellar furrows directed posteriorly, observable on exfoliated specimens. Occipital ring slightly bowed anteriorly in center and then recurving forward at lateral extremities; dorsal furrow moderately impressed at sides, fainter in front of glabella. Brim convex, sloping downward, continuing curve of glabella along axial line, one and one-half times as broad as steeply upturned, crescentic border; marginal furrow deep. Fixed cheeks one-half width of glabella, slightly convex; palpebral lobes short, located a little anterior to midpoint of glabella; shallow palpebral furrow; faint ocular ridge extending to dorsal furrow. Posterior limbs long, triangular, with well marked furrow. Free cheek unknown.

Facial suture curves around marginal furrow and slants inward to palpebral lobe, then trends around palpebral lobe and bends outward and backward intersecting posterior margin at about 40° angle.

Occipital ring, posterior limb, and posterior portion of glabella and fixed cheek finely granulose on some specimens.

Remarks.—This species is very abundant in both the Arbuckle and Wichita Mountains. It differs from *Dellea wilbernsensis* Wilson in having a more steeply upturned border, less impressed glabellar furrows, and increased degree of curvature of the lateral areas of the brim away from the dorsal furrow.

Occurrence.—Upper Cambrian, Honey Creek formation, (*Elvinia* zone), Arbuckle and Wichita Mountains, localities 8, 9, 10, 11, 13, and 14.

Holotype.—Cranidium, O. G. M. 105-16F-29, locality 8; paratype, cranidia, O. G. M. 105-16F-20, 31; 164a, 164b; locality 9.

DELLEA BUTLERENSIS Frederickson, n. sp.
Plate 69, figures 16–18

Cranidium elongate, very convex in both directions; glabella and occipital ring constitute over two-thirds length of cranidium; glabella elongate, highly convex, bulbous, raised high above fixed cheeks, tapering slightly anteriorly, broadly rounded in front; two pairs of faint glabellar furrows. Occipital ring widest at center; occipital furrow deeply impressed at sides, fainter over center where it curves slightly forward; dorsal furrow well defined. Brim convex, sloping downward; border convex, crescentic, nearly equal to brim in width; marginal furrow deep, concave. Fixed cheeks narrow, slightly over one-third width of glabella, gently downsloping; palpebral lobes elongate, narrow, located just anterior to glabella midpoint; shallow palpebral furrow; faint ocular ridge, Posterior limbs triangular, sloping steeply away from glabella and fixed cheek, marginal furrow continuation of occipital furrow. Free cheek unknown.

Facial suture cuts frontal margin on line with side of glabella, trends around marginal furrow and slants inward to and around palpebral lobe and then outward to posterior margin.

Remarks.—*Dellea butlerensis* differs from *D. juvenalis* in the narrower fixed cheeks and shorter brim and border, which gives the cranidium an elongate aspect; and in the bulbous and very convex glabella.

Occurrence.—Honey Creek formation, (*Elvinia* zone), Wichita Mountains, localities 8 and 9.

Holotype.—Cranidium, O. G. M. 105-16F-165a, locality 9; paratype, O. G. M. 105-16F-165b, locality 8.

Genus ELVINIA Walcott, 1924
ELVINIA ROEMERI (Shumard)
Plate 69, figures 19–21

Dikelocephalus roemeri SHUMARD, 1861, Am. Jour. Sci., 2d ser., vol. 32, pp. 220, 221.
Elvinia roemeri (Shumard) WALCOTT, 1924, Smithsonian Misc. Coll., vol. 75, no. 2, p. 56, pl. 11, fig. 3.
Elvinia roemeri (Shumard) MILLER, 1932, Jour. Paleontology, vol. 10, no. 1, p. 30, pl. 8, fig. 36.
Elvinia roemeri (Shumard) BRIDGE and GIRTY, 1937, U. S. Geol. Survey, Prof. Paper 186-M, pp. 251, 255 (for synonomy to date), pl. 69, figs. 1–21.
Elvinia tetonensis RESSER, 1937, Smithsonian Misc. Coll., vol. 95, no. 22, p. 12.
Elvinia texana RESSER, 1938, Smithsonian Misc. Coll., vol. 97, no. 10, p. 30.
Elvinia shumardi RESSER, 1938, idem pp. 30, 31.
Elvinia bridgei RESSER, 1938, idem., p. 31; 1942, Smithsonian Misc. Coll., vol. 103, no. 5, pp. 97–98, pl. 18 figs. 28–31, pl. 19, figs. 1–5.
Elvinia missouriensis RESSER, 1938, idem., pp. 31, 32.
Elvinia dakotensis RESSER, 1938, idem., p. 32.
Elvinia matheri (Walcott) RESSER, 1938, idem., p. 33.
Elvinia gregalis RESSER, 1942, Smithsonian Misc. Coll., vol. 103, no. 5, pp. 96, 97, pl. 18, figs. 18–23.
Elvinia longa RESSER, 1942, idem., p. 97, pl. 18, figs. 24–27.
Elvinia vagans RESSER, 1942, idem., p. 98, pl. 19, figs. 6–9.
Elvinia brevifrons RESSER, 1942, idem., pp. 98–99, pl. 19, figs. 10–14.
Elvinia roemeri (Shumard) SHIMER and SHROCK, 1944, Index Fossils of N. Amer., p. 625, pl. 264, figs. 34–37.
Elvinia shumardi Resser SHIMER and SHROCK, 1944, idem., p. 625, pl. 264, figs. 41, 42.
Elvinia matheri (Walcott) SHIMER and SHROCK, 1944, idem., p. 625, pl. 264, fig. 40.
Elvinia roemeri (Shumard) WILSON, 1949, Jour. Paleontology, vol. 23, no. 1, p. 38, pl. 10, figs. 5, 9, 10, 12, 13.

Remarks.—Specimens of *Elvinia roemeri* are extremely abundant in the *Elvinia* zone of the Honey Creek formation in all localities visited. Many specimens were collected during the present study and an examination of them showed that what at first appeared to be several different species of *Elvinia* actually are individuals belonging to *E. roemeri* and representing various stages of growth. Specimens of the same size are similar in appearance; and specimens arranged in sequence from small to large show gradual minor changes. Thus, when a small or immature individual is compared with a large or mature individual a marked difference is noticeable. Bridge and Girty, (1937, p. 254) in their discussion of *Elvinia roemeri*, noted this variation among individuals from one locality and

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EXPLANATION OF PLATE 70

FIGS. *1–6*—*Bernia obtusa* Frederickson, n. sp. *5*, *6*, Holotype; dorsal and profile views of cranidium showing concave brim, ×3, O. G. M. 105-16F-82, loc. 16. *1*, Paratype; cranidium, ×4, O. G. M. 105-16F-38, loc. 14. *2*, Paratype; cranidium, ×3, O. G. M. 105-16F-83, loc. 16. *3*, Paratype; cranidium, ×4, O. G. M. 105-16F-80, loc. 9. *4*, Paratype; cranidium, ×4, O. G. M. 105-16F-166, loc. 9. (p. 358)

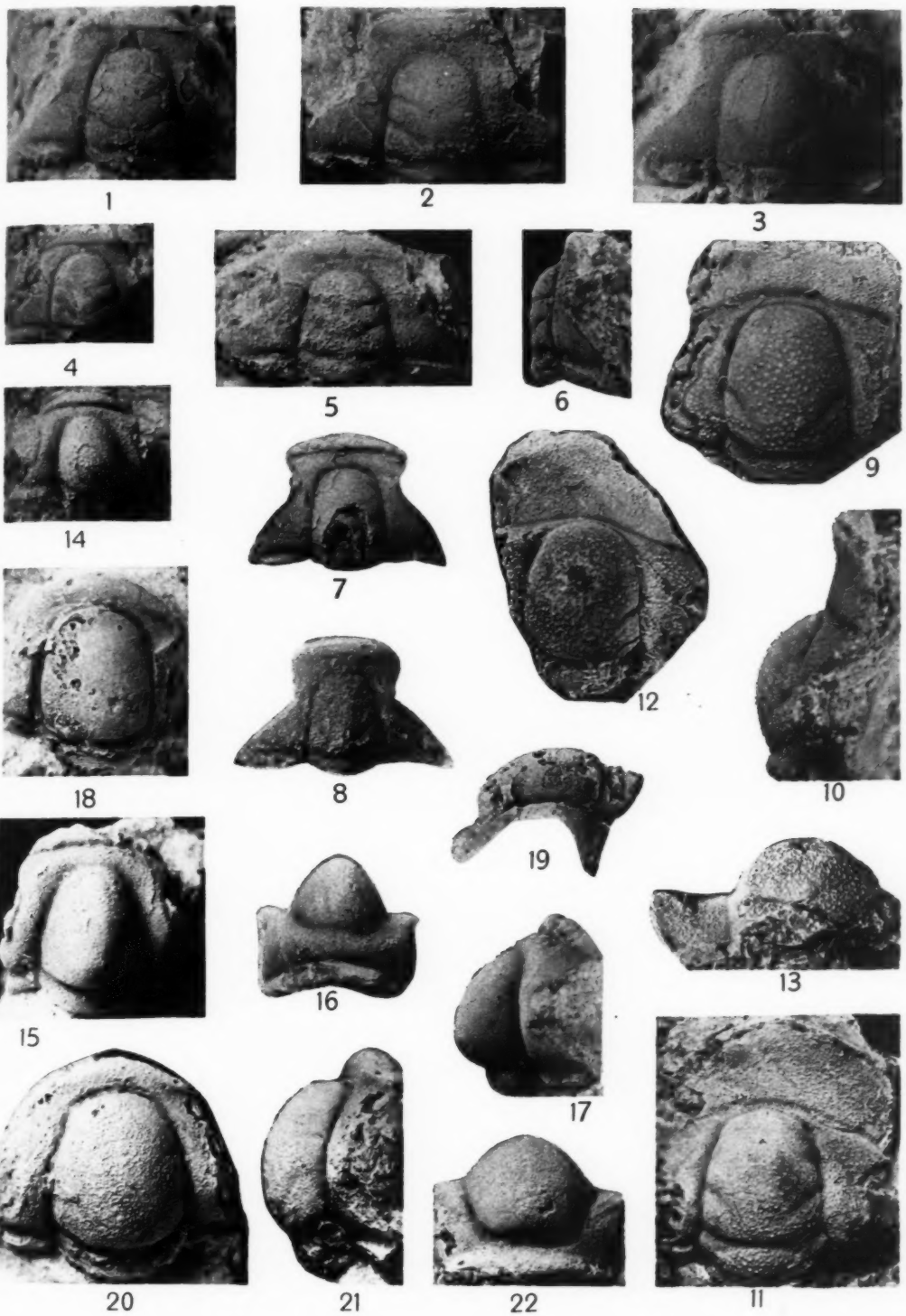
7, *8*—*Parabolinoides hebe* Frederickson, n. sp. *7*, Paratype; cranidium, ×3, O. G. M. 105-16F-57a, loc. 14. *8*, Paratype; cranidium, ×3, O. G. M. 105-16F-57b, loc. 16. (p. 361)

9–11—*Burnetia exilis* Resser. *9*, Hypotype; cranidium, ×2, O.G. M. 105-16F-28, loc. 12. *10*, *11*, Hypotype; profile and dorsal views of cranidium, ×2, O. G. M. 105-16F-26, loc. 12. (p. 348)

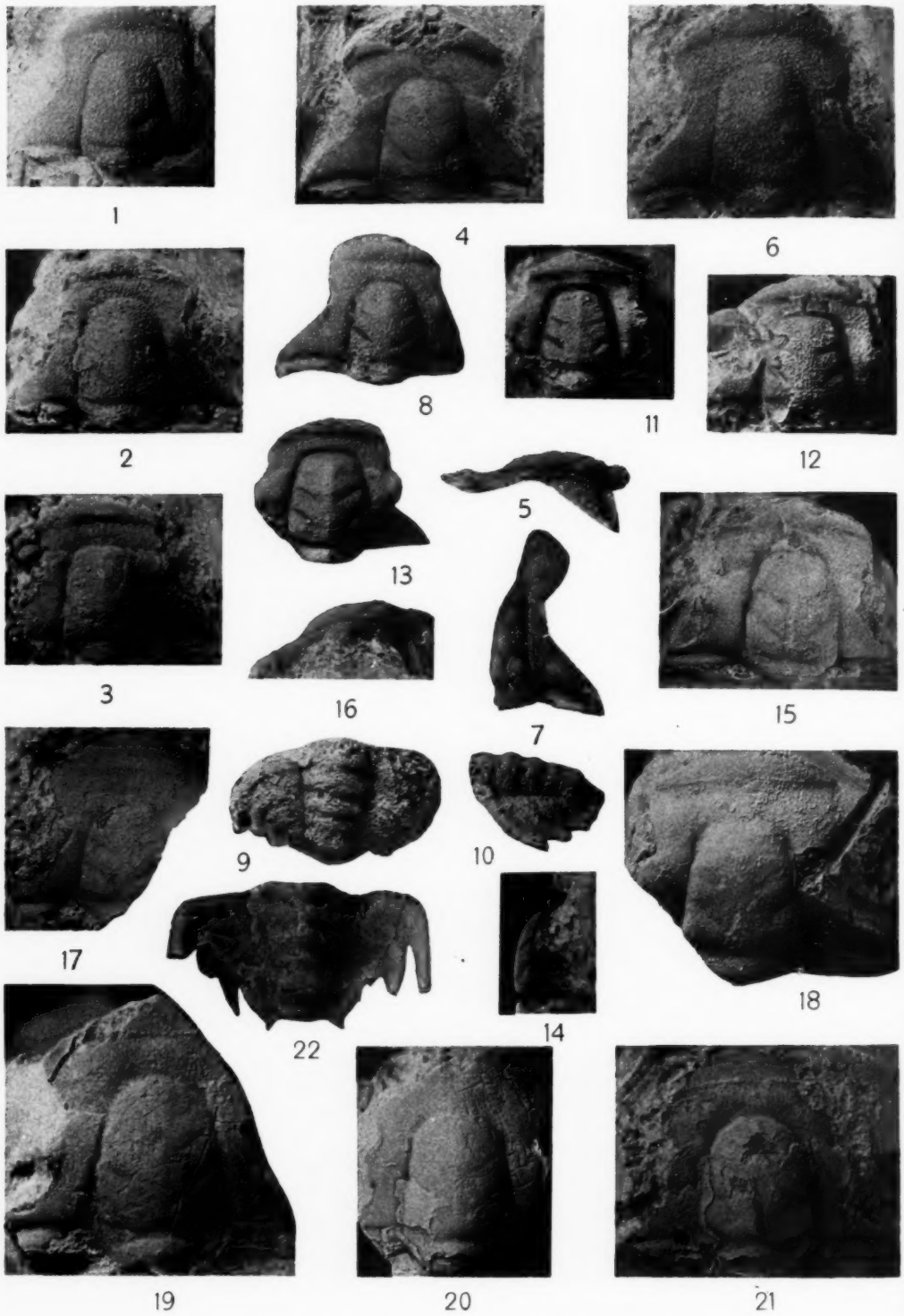
12, *13*—*Burnetia urania* (Walcott). Hypotype; dorsal and profile views of fragmental cranidium, ×2, O. G. M. 105-16F-27, loc. 11. (p. 348)

14–17—*Apachia trigonis* Frederickson, n. sp. *15–17*, Holotype; dorsal, anterior and profile views of largest cranidium, ×4, O. G. M. 105-16F-167a, loc. 8. *14*, Paratype; small cranidium with complete border, ×4, O. G. M. 105-16F-167b, loc. 8. (p. 346)

18–22—*Kiowaia timberensis* Frederickson, n. sp. *20–22*, Holotype; dorsal, profile and anterior views of large cranidium, ×3, O. G. M. 105-16F-1, loc. 15. *18*, *19*, Paratype; dorsal and profile views of cranidium, ×3, O. G. M. 105-16F-47, loc. 14. (p. 356)



Frederickson, Upper Cambrian Trilobite Fauna



Frederickson, Upper Cambrian Trilobite Fauna

further observed that individual variations within one species of *Elvinia* were often greater than variations between types of different species.

Resser, in assigning various specimens illustrated by Bridge and Girty to new species of *Elvinia*, failed to take these individual variations into consideration, and based the new species on minor differences which cannot be considered of specific character. Furthermore, in two instances Resser assigned the same specimen illustrated by Bridge and Girty to two different species; namely, fig. 15 to *E. texana* and *E. roemeri*, and figure 10 to *E. shumardi* and *E. roemeri*.

Resser, (1942, pp. 96–99), described and illustrated four new species of *Elvinia* from Oklahoma and illustrated *E. bridgei* which he had previously described. The species were distinguishable, according to Resser, on the following characteristics:

1. Ratio of brim and border to cranidial length. (Col. 1 of Table)
2. Tapering of glabella. (Col. 2 of Table)
3. Relationship of border to brim. (Col. 3 of Table)
4. Divergence of facial suture. (Cols. 4 and 5 of Table)
5. Ratio of fixed cheeks to glabella width on line anterior to eye. (Col. 6 of Table)

The following table based on measurements taken from Resser's types and utilizing the same characteristics used by Resser to distinguish these species, clearly shows that in many instances holotypes of species designated by Resser show closer similarities to other species described by him than to the paratype assigned to the same species. Notice also the close agreement in all characteristics among specimens of the same general size as indicated by measurements in Columns 4 and 5 of the table.

Occurrence.—Upper Cambrian, Honey Creek formation (*Elvinia* zone), Arbuckle and Wichita Mountains, all localities in which *Elvinia* zone is exposed.

Hypotype.—Cranidia, O. G. M. 105-16F-65, locality 13; O. G. M. 105-16F-68, locality 8; hypotype, pygidium, O. G. M. 105-16F-64, locality 12.

Genus IRVINGELLA Ulrich and Resser, 1924

IRVINGELLA MAJOR Ulrich and Resser

Plate 69, figures 5–7

Irvingella silvestris RESSER, 1942, Smithsonian Misc. Coll., vol. 103, no. 5, pp. 13–14, pl. 2, figs. 22–27.

Irvingella arbucklensis RESSER, idem., pp. 14–15, pl. 2, figs. 28–33.

Irvingella mesleri RESSER, idem., p. 15, pl. 2, figs. 34–38.

Irvingella recurva RESSER, idem., pp. 15–16, pl. 2, figs. 39–41.

Irvingella alia RESSER, idem., p. 16, pl. 2, figs. 42–47.

Irvingella ardmorensis RESSER, idem., p. 18, pl. 3, figs. 7–12.

Irvingella alta RESSER, idem., p. 19, pl. 3, figs. 16–18.

EXPLANATION OF PLATE 71

FIGS. *1–3—Parabolinoides hebe* Frederickson, n. sp. *1*, Holotype; cranidium, ×2, O. G. M. 105-16F-36b, loc. 16. *2*, Paratype; cranidium, ×3, O. G. M. 105-16F-35, loc. 16. *3*, Paratype; cranidium, ×3, O. G. M. 105-16F-36a, loc. 16. (p. 361)

4–10—Parabolinoides contractus Frederickson, n. sp. *4*, *5*, Holotype; dorsal and profile views nearly complete cranidium, ×3, O. G. M. 105-16F-33a, loc. 16. *6*, *7*, Paratype; dorsal and profile views of cranidium, ×3, O. G. M. 105-16F-33b, loc. 16. *8*, Paratype; cranidium, ×3, O. G. M. 105-16F-33c, loc. 16. *9*, *10*, Paratype; dorsal and profile views of associated pygidium, ×3, O. G. M. 105-16F-37, loc. 16. (p. 361)

11–14—Bemaspis gouldi Frederickson, n. sp. *13*, *14*, Holotype; dorsal and profile views of cranidium, ×4, O. G. M. 105-16F-6b, loc. 14. *11*, Paratype; cranidium, ×4, O. G. M. 105-16F-6a, loc. 14. *12*, Paratype; cranidium, ×4, O. G. M. 105-16F-6c, loc. 14. (p. 357)

15–18—Orygmaspis firma Frederickson, n. sp. *15*, *16*, Holotype; dorsal and profile views of nearly complete cranidium, ×2, O. G. M. 105-16F-59, loc. 14. *17*, Paratype; flattened cranidium on same slab as holotype, ×2, *18*, Paratype; large cranidium, ×2, O. G. M. 105-16F-58, loc. 14. (p. 359)

19–22—Orygmaspis llanoensis (Walcott). *19*, Hypotype, cranidium, ×2, O. G. M. 105-16F-46a, loc. 11. *20*, Hypotype, cranidium, ×2, O. G. M. 105-16F-46c, loc. 11. *21*, Hypotype, cranidium, ×2, O. G. M. 105-16F-46b, loc. 11. *22*, Hypotype, pygidium, ×2, O. G. M. 105-16F-46d, loc. 9. (p. 359)

Irvingella deckeri RESSER, idem., pp. 19–20, pl. 3, figs. 19–27.

Remarks.—Resser (1942) described a number of new species of *Irvingella*. Although many of these species are from other localities and therefore beyond the scope of this paper, the incompleteness of the work on the Oklahoma forms casts strong doubt on the validity of many of the other new species. Resser's descriptions of the Oklahoma forms are incomplete and in many instances inaccurate. For example, *I. silvestris* is described as having free cheeks equal to one-third the glabellar width whereas the illustration (Resser, 1942, pl. 2, fig. 27) measures approximately one-half. Measurements of the actual illustrated specimen substantiated this. In the description of *I. arbucklensis*, Resser states that the eyes (fixed cheeks) "are the shortest of any species observed," whereas the holotype and paratype are similar in this respect to the other Oklahoma forms. Similarly, *I. recurva* is described as having vertical fixigenes (fixed cheeks) whereas they actually are downsloping at approximately a 30° angle. Many other examples could be listed, but almost never were any details given by which the new species could be distinguished from one another. Upon examining the actual specimens I was unable to distinguish any specific differences from *Irvingella major*, the genotype.

TABLE II

ELVINIA	Ratio brim and border to lgth. cran.	Ratio ant. glab. width to post. glab. at occ. furrows	Ratio border to brim	Length of brim	Width across cran. in front of eyes	Ratio fixed cheek ant. to eye to glab.
	1	2	3	4	5	6
				mm.	mm.	
E. longa						
holotype	1:3.8	1:1.8	1:2.2	24	22	1:1.5
paratype	1:3.66	1:2	1:2	19	17	1:1.8
E. bridgei						
cotype 93025	1:3.8	1:2	1:2	19*	18	1:2
cotype 108820a	1:3.5	1:1.8	1:2	17.5	17	1:2
E. vagans						
holotype	1:4	1:1.6	1:2	19	18*	1:3
paratype	1:3.7	1:2	1:1.9	11	10	1:2
E. brevifrons						
holotype	1:5	1:1.6	1:1.5	9	8	1:2.2
paratype	1:3.9	1:1.7	1:1.9	12†	12	1:1.5
E. gregalis						
holotype	1:4	1:1.8	1:2.5	9.5*	9	1:2
paratype	1:3	1:2	1:2	10.7	10.5	1:1.7

* Estimated where part missing.
† Due to high arching across brim because of depressed lateral portions.

The species described by Resser from Oklahoma were, however, readily divided into three general groups characterized by differences in convexity measured in a plane at right angles to the axis. These differences are not the result of preservation for numerous specimens of each group are available. These groups and Resser's species which are characteristic of each group are as follows:

Group I—Least convex of the three groups. In cross section, glabella gently and evenly convex at sides with greatest convexity at center. Fixed cheeks convex and gently downsloping.

Irvingella alia Resser
Irvingella ardmorensis Resser

Group II—Glabella very convex, nearly hemispherical in cross section. Fixed cheeks steeply downsloping at approximately a 30° angle.

Irvingella alta Resser
Irvingella recurva Resser

Group III—Glabella moderately convex over central portion in cross section, but nearly vertical at sides sloping into dorsal furrow. Fixed cheeks convex and gently downsloping laterally.

Irvingella silvestris Resser
Irvingella arbucklensis Resser
Irvingella mesleri Resser
Irvingella deckeri Resser

The occurrence of the three groups was checked for the possibility that the specimens might represent one of the rare examples of geographic variation in paleontology. However, with the exception of the members of group III, which were found only in the Arbuckle Mountain area, there is no evidence of isolation. Indeed, specimens characteristic of all three groups occur among the numerous *Irvingella* cranidia collected from locality 14 in the Arbuckle Mountains. Lochman (1947, p. 61) has suggested that minor variations in the convexity of the glabella and fixed cheeks are possibly of specific value. However, in view of the fact that the groups apparently constituted one population, and in the absence of other specific differences, I do not consider the variations present in the Oklahoma *Irvingellas* to be of either specific or subspecific value and accordingly have assigned Resser's species representative of these groups to *Irvingella major* Ulrich and Resser.

Occurrence.—Honey Creek formation, (*Elvinia* and *Ptychopleurites* zones), Arbuckle and Wichita Mountains, localities 8, 9, 10, 11, 12, 13, 14, 15 and 16.

Hypotypes.—Cranidia, O. G. M. 105-16F-48; O. G. M. 105-16F-49, locality 14.

Genus PLATASPELLA Wilson, 1949
PLATASPELLA ANATINA (Resser)
Plate 68, figures 10–13

Iddingsia anatina RESSER, 1942, Smithsonian Misc. Coll., vol. 103, no. 5, p. 89, pl. 17, figs. 1, 2.
Plataspella anatina (Resser) WILSON, 1949, Jour. Paleontology, vol. 23, no. 1, pp. 11–42, pl. 9, figs. 20–22, 25, 26.

This species is especially abundant in my collections and is a conspicuous form in the *Elvinia* zone. Specimens preserving the spine are rare, probably because of the steep angle of inclination of the spine in relation to the occipital ring.

Occurrence.—Honey Creek formation, (*Elvinia* zone), Arbuckle and Wichita Mountains, localities 8, 9, 10, 11, 12, and 13.

Hypotypes.—Cranidia, O. G. M. 105-16F-7; O. G. M. 105-16F-8, locality 12.

Genus PTEROCEPHALIA Roemer, 1849
PTEROCEPHALIA SANCTISABAE Roemer
Plate 69, figures 1–4

Pterocephalia sanctisabae ROEMER, 1849, Texas, p. 421.
Pterocephalia sanctisabae Roemer BRIDGE and GIRTY, 1937, U. S. Geol. Survey, Prof. Paper 186-M, p. 246 (for synonomy to date), pl. 67, fig. 1a–d; pl. 68, fig. 7–22, 31; [non?] figs. 23–30, 32–43 (Resser, 1938, Smithsonian Misc. Coll., vol. 97, no. 10, pp. 39–41).
Pterocephalia ulrichi RESSER, 1938, idem., p. 41.
Pterocephalia silvestri RESSER, 1938, idem., p. 41.
Pterocephalia deckeri RESSER, 1938, idem., p. 41.
Pterocephalia sanctisabae Roemer SHIMER and SHROCK, 1944, Index Fossils of N. Amer., p. 631, pl. 266, figs. 35–37.
Pterocephalia sanctisabae Roemer WILSON, 1949, Jour. Paleontology, vol. 23, no. 1, p. 42, pl. 10, figs. 1–3.

Remarks.—Bridge and Girty (1937) studied and redescribed the original types of *Pterocephalia sanctisabae* Roemer. Specimens of *Pterocephalia* from Missouri, Nevada, Oklahoma, South Dakota and Texas were also studied by them and assigned to *P. sanctisabae* on the basis of detailed comparison and measurements. Resser (1938) reassigned certain of the specimens illustrated by Bridge and Girty to nine species, of which seven were new species, and the other two a resurrection of *P. multicincta* (Hall and Whitfield) and *P. laticeps* (Hall and Whitfield) which Bridge and Girty in a detailed discussion had shown to be conspecific with *P. sanctisabae*. Resser merely listed the synonomy and occurrence of these two species and did not refute the arguments of Bridge and Girty.

In the very incomplete descriptions of the seven new species Resser in only two cases listed differences by which the species might be distinguished.

In this paper I am concerned only with those species erected by Resser on specimens from Oklahoma. The other species are outside the scope of this study. Species

based on specimens from Oklahoma are *P. ulrichi*, *P. silvestris* and *P. deckeri*.

In the description of *P. ulrichi*, Resser gave no differences by which this species could be distinguished from *P. sanctisabae*. He commented upon the width of the flaring brim and stated "this is the widest species thus far found." Based on published measurements of the specimen illustrated by Bridge and Girty which Resser chose as the paratype (measurements are incomplete on Resser's holotype) the ratio of width of brim to length of cephalon is 1.0; the same ratio determined from two syntypes and a topotype of *P. sanctisabae* are as follows: syntype A = .90, syntype B = .857, topotype U.S.N.M. 93012 = .96. This illustrates the individual variation of the width of the cranidium within specimens which Resser apparently accepted as *P. sanctisabae*, and I do not consider it a sufficient specific difference upon which to erect a new species.

Resser described *P. silvestris* very briefly as follows: "This is also a wide form and has a very large brim. Compared with *P. ulrichi*, the brim is longer and the dorsal and glabellar furrows shallower." The ratio of length of brim to length of cephalon in Resser's types as determined from Bridge and Girty's measurements is as follows: paratype *P. ulrichi* = .594, holotype *P. silvestris* = .606. Actual measurements of the two cranidia which vary only one millimeter in the length of the cranidium do not show a variance of over one millimeter in any measurement. Thus, *P. silvestris* cannot be distinguished from *P. ulrichi* which I consider conspecific with *P. sanctisabae*.

Pterocephalia deckeri was briefly described by Resser but no characteristics by which it could be distinguished from the other species he established were listed. The holotype specimen, which was the sole specimen used to establish *P. deckeri* is a fragmentary cranidium and the description lists no characteristics not applicable to *Pterocephalia sanctisabae*.

Occurrence.—Upper Cambrian, Honey Creek formation, (*Elvinia* zone), Arbuckle and Wichita Mountains, localities 6, 7, 8, 9, 10, 11, 13 and 14.

Hypotypes.—Cranidia, O. G. M. 105-16F-54 105-16F-56, locality 11; hypotype, pygidium, O. G. M. 105-16F-61, locality 13.

PTYCHOPLEURITES ZONE FAUNA

Genus KIOWAIA Frederickson, n. gen.

Cranidium rectangular, very convex; glabella tumid, wide, subconical, broadly rounded at front; two pairs of faint glabellar furrows, posterior pair markedly oblique; dorsal and occipital furrows deep, narrow; occipital ring regular and convex. Narrow brim, absent in front of glabella where marginal furrow joins dorsal furrow; raised convex, triangular border. Fixed cheeks very narrow, convex; palpebral lobes small, elevated; faint ocular ridge. Posterior limbs narrow, moderately long with broad deep marginal furrow.

Genotype.—*Kiowaia timberensis* Frederickson, n. sp.

Remarks.—The genus *Kiowaia* is based on one species, *K. timberensis* Frederickson. The genus is very similar to *Avonaspis* Lochman especially in the shape of the glabella and the brim and border. However, the triangular shaped occipital ring and wider fixed cheek of *Avonaspis* serve to distinguish the two genera, which are also widely separated stratigraphically.

KIOWAIA TIMBERENSIS Frederickson, n. sp.
Plate 70, figures 18–22

Cranidium small, rotund; glabella subconical, rounded in front, convex, swollen anteriorly and partially overhanging dorsal furrow; two pairs of glabellar furrows, anterior pair faint and straight, posterior pair more pronounced, curved sharply backward; dorsal and occipital furrow deeply impressed; occipital ring convex, of equal width. Brim narrow, steeply dipping at sides, absent in front of glabella where shallow marginal furrow becomes tangent to dorsal furrow; border convex, triangular, bluntly pointed. Fixed cheeks very narrow; palpebral lobes located opposite posterior pair glabellar furrows, narrow, elongate. Posterior limbs narrow, elongate; wide marginal furrow. Free cheek not known.

Facial suture intramarginal to cranidium to form triangular border, thence trends nearly straight backwards to palpebral lobe around which it curves and then backward and outward in smooth concave curve to cut posterior margin within the genal angle.

Outer surface of test smooth.

Pygidium not known.

Remarks.—This species is found in the *Irvingella* coquina in the Honey Creek formation. It is associated with *Ptychopleurites* and *Irvingella* in the thin *Ptychopleurites* zone just above the *Elvinia* zone.

Occurrence.—Upper Cambrian, Honey Creek formation, Arbuckle Mountains, localities 14 and 15.

Holotype.—Cranidium, O. G. M. 105-16F-1, locality 15; paratype, cranidium, O. G. M. 105-16F-47, locality 14.

CONASPIS ZONE FAUNA

Genus BEMASPIS Frederickson, n. gen.

Cranidium broad; glabella keeled, tapering convex, rounded-truncate anteriorly; three pairs of oblique glabellar furrows; occipital furrow and ring plainly defined, small occipital node; dorsal furrow narrow and deep. Brim convex, marginal furrow straight and deep; border convex, equal in width to brim along axial line, tapering laterally. Fixed cheeks equal to one-half width of glabella at midpoint, flat at center; palpebral lobes large, rounded; faint ocular ridge. Posterior limbs triangular, sloping steeply laterally; marginal furrow prominent.

Remarks.—Bemaspis is characterized by its short broad cranidium, large palpebral lobes, and keeled glabella. The genus is represented by only one species.

Genotype.—Bemaspis gouldi Frederickson, n. gen.

BEMASPIS GOULDI Frederickson, n. sp.
Plate 71, figures 11–14

Cranidium broader than long. Glabella four-fifths length of cranidium, convex, keeled, tapering at sides, rounded-truncate anteriorly; three pairs of oblique glabellar furrows, anterior pair very faint, others impressed; occipital furrow and ring well defined, small occipital node; dorsal furrow narrow, deep. Brim convex, equal in width to border along axial line, separated from obtusely pointed, convex, raised border by nearly straight, well defined marginal furrow. Fixed cheeks one-half as wide as glabella at midpoint, nearly flat at eyes but sloping steeply anteriorly and posteriorly; palpebral lobes large, rounded, located opposite second pair of glabellar furrows; faint ocular ridge continuing curvature of palpebral lobe. Posterior limbs triangular, sloping steeply away from glabella and palpebral lobe, convex, marked by prominent marginal furrow. Free cheek unknown.

Facial suture expands very slightly forward from palpebral lobes, and cuts anterior border at midpoint; posteriorly it trends outward and backward at sharp angle.

Outer surface of test very minutely granulose.

Remarks.—A number of cranidia of *Bemaspis gouldi* have been found at locality 14 in the Arbuckle Mountains where they are present in the base of the *Taenicephalus* subzone. The holotype cranidium measures 6 mm. long, 10 mm. wide across the posterior limbs.

Occurrence.—Honey Creek formation (*Taenicephalus* subzone), Arbuckle Mountains, locality 14.

Holotype.—Cranidium, O. G. M. 105-16F-6b; paratypes, cranidia, O. G. M. 105-16F-6a, c; locality 14.

Genus BERNIA Frederickson, n. gen.

Cranidium short and wide. Glabella short, slightly tapering, broadly rounded anteriorly, raised convex; three pairs of glabellar furrows, anterior pair faint and straight, posterior two pairs oblique; dorsal furrow deep at sides and shallowing anteriorly; occipital furrow deep, occipital ring with small node. Brim flatly concave in front of glabella; border convex, slightly tapering laterally, raised above nearly straight, shallow marginal furrow. Fixed cheeks less than one-half glabellar width at midpoint; palpebral lobes small; faint ocular ridge located at downward flexure of fixed cheek. Posterior limbs broadly triangular; marginal furrow well defined.

Remarks.—Only one species of the new genus, *Bernia*, has been found in the Oklahoma collections. The glabella is similar to that of *Conaspis*, but the broader concave brim and the wide triangular posterior limbs of *Bernia* are very different from the narrow, convex, cord-like brim and the narrow, concave curved limbs of *Conaspis*.

Genotype.—Bernia obtusa Frederickson, n. sp.

BERNIA OBTUSA Frederickson, n. sp.
Plate 70, figures 1–6

Cranidium short and wide; glabella short, sub-conical, rounded at front, convex; three pairs of oblique glabellar furrows, anterior pair faint and short, posterior pair connected across glabella by faint straight furrow in some specimens; dorsal furrow deep on sides, shallower in front of glabella; occipital furrow impressed, very slightly bowed forward at center; occipital ring slightly narrower at sides but equal in length to posterior width of glabella, small median node. Brim flatly concave anterior to glabella, convex laterally; border raised, convex, tapering slightly, equal in width to brim; marginal furrow shallow, almost straight, formed by junction of raised border and concave brim. Fixed cheeks less than one-half width of glabella, gently downsloping; palpebral lobes small, slightly elevated, located opposite glabellar lobe between first and second pairs of glabellar furrows; faint straight ocular ridge. Posterior limbs very broadly triangular, convex, sloping away from glabella, four-fifths the length of occipital ring. Free cheeks unknown.

Facial suture cuts anterior border nearly at center, trends laterally around marginal furrow and then nearly straight backward to palpebral lobes around which it curves and then trends laterally and backward in a smooth gently convex curve to posterior margin.

Pygidium not known.

Remarks.—This genus is represented by a number of cranidia which were found associated with *Parabolinoides contractus* and *Eoorthis*. The holotype cranidium measures 8 mm. in length, 7½ mm. across the palpebral lobes and 14 mm. across the posterior limbs.

Occurrence.—Honey Creek formation (*Eoorthis* subzone), Arbuckle and Wichita Mountains, localities 9, 14, 15 and 16.

Holotype.—Cranidium, O. G. M. 105-16F-82, locality 16; paratypes, cranidia, O. G. M. 105-16F-38, 105-16F-83, locality 16; O. G. M. 105-16F-166, locality 14; O. G. M. 105-16F-80, locality 9.

Genus IDAHOIA Walcott, 1924
IDAHOIA ? LONGA Frederickson, n. sp.
Plate 72, figures 10–12

Several fragmental cranidia are all that is known of this species which is tentatively assigned to *Idahoia*.

Cranidium elongate. Glabella long, convex, tapering, rounded anteriorly; three pairs of glabellar furrows, first and second pair straight, third pair oblique; occipital furrow straight at center, oblique at sides; occipital ring tapering at sides, widest at center; occipital node present; dorsal furrow deeply impressed at sides, becoming fainter anteriorly. Brim flatly convex, dipping away from glabella; border flat, over twice as wide as brim, upturned along marginal furrow; marginal furrow narrow, forming broad inverted V with point along axis of cranidium. Fixed cheeks inclined at 45° angle from horizontal; palpebral lobes unknown; raised, narrow ocular ridge. Posterior limbs and free cheeks unknown.

Occurrence.—Honey Creek formation (*Taenicephalus* subzone), Arbuckle Mountains, locality 11.

Genus MEERIA Frederickson, n. gen.

Cranidium elongate; glabella flatly convex, with faint keel, subrectangular in shape; three pairs of faint glabellar furrows; occipital furrow wide, well marked at sides; occipital ring widest and elevated at center, flatly convex; dorsal furrow distinct, shallow anterior pits. Brim slightly convex, dipping away from glabella; border flatly convex and continuing dip of brim, crescentic with blunt central point; marginal furrow wide and shallow. Fixed cheeks narrow; palpebral lobes large, hemispherical; faint ocular ridge. Posterior limbs long, narrow, strap-like; marginal furrow shallow.

Remarks.—A number of cranidia, ranging from those of immature individuals to adults, of this new genus have been found. The cranidium is characterized by the broadly tapering and blunt glabella, anterior pits, large centrally located palpebral lobes, and narrow, strap-like posterior limbs. The adult cranidia show many similarities to *Taenicephalus* and may have arisen independently from the same ancestral species.

Genotype.—*Meeria lirae* Frederickson, n. sp.

MEERIA LIRAE Frederickson, n. sp.
Plate 72, figures 3–6

Cranidium elongate, narrow except across posterior limbs; glabella flatly convex,

faintly keeled, subrectangular, sides moderately convergent anteriorly and contracted slightly opposite eyes, rounded-truncate in front; three pairs of faint glabellar furrows; occipital furrow impressed at sides, nearly obsolete at dorsal furrow and shallow across center of glabella; occipital ring narrow at sides, slightly wider and distinctly elevated in center, young individuals with median node which is not present in adults; dorsal furrow plain, widening in preglabellar area to form shallow depressions which indent antero-lateral angles of glabella. Brim slightly convex, dipping gently away from glabella, about twice as wide as the border and separated from it by wide shallow marginal furrow which is very faint in young forms; border continuing dip of brim, crescentic with sides meeting at about 150° angle to form blunt point. Fixed cheeks narrow; slightly less than one-third glabellar width; palpebral lobes large, located opposite middle of glabella; faint oblique ocular ridge. Posterior limbs narrow, elongate, with shallow marginal furrow. Free cheeks unknown.

Facial suture intramarginal to center of border, continues laterally to form broad point of border then curves smoothly but sharply backwards and inwards to and around palpebral lobes and then laterally forming strap-like posterior limbs.

Outer surface of test smooth.

Pygidium not known.

Remarks.—Fortunately, my collections contained a number of individuals of various sizes. These indicate that the marginal furrow between the brim and border evidently is a mature feature as a gradual increase in development of the furrow occurs concurrently with increase in size of the individual. Conversely, the occipital node is present in young individuals but absent in adults.

Occurrence.—Upper Cambrian, Honey Creek formation, upper part of *Taenicephalus* subzone and basal portion of Ft. Sill formation, Arbuckle and Wichita Mountains, localities 6 and 11.

Holotype.—Cranidium, O. G. M. 105-16F-41, locality 6; paratypes, cranidia, O. G. M. 105-16F-40, O. G. M. 105-16F-42, locality 6.

Genus ORYGMASPIS Resser, 1937

Two species of this genus have been found in the Honey Creek formation, *Orygmaspis llanoensis* (Walcott) and a new species, *Orygmaspis firma* Frederickson. Both species of *Orygmaspis* differ from *Parabolinoides* in having much narrower posterior limbs, larger, more centrally located palpebral lobes, a straighter marginal furrow, and a keeled glabella. Although Resser did not mention an occipital node in the original description of the genus, both species from Oklahoma show this feature plainly.

ORYGMASPIS LLANOENIS (Walcott)
Plate 71, figures 19–22

Ptychoparia llanoensis WALCOTT, 1890, Proc. U. S. Nat. Mus., vol. 13, p. 272, pl. 21, figs. 3–5.
Ptychoparia llanoensis WALCOTT, 1899, U. S. Geol. Surv. Mon. 32, pt. 2, p. 458, pl. 64, fig. 4.
Conaspis llanoensis WALCOTT, 1914, Smithsonian Misc. Coll., vol. 57, no. 13, p. 358.
Orygmaspis llanoensis (Walcott) RESSER, 1937, Smithsonian Misc. Coll., vol. 95, no. 22, pp. 21, 22.

The exfoliated specimens all show the row of tiny granules along the position of the marginal furrow, noted by Resser in the original description of the genus. The pygidium, described below, was found associated with *O. llanoenis* and is tentatively assigned to this species.

Pygidium wider than long; axis composed of five segments, raised convex, and gradually tapering posteriorly; three pairs of laterally directed pleural segments bending sharply posteriorly near margin and ending in elongate spines; one pair of small marginal spines on posterior border opposite sides of axis.

Occurrence.—Honey Creek formation (*Taenicephalus* subzone), associated with *O. firma* and *Taenicephalus*, localities 9, 11, 14 and 15.

Hypotype.—Cranidia, O. G. M. 105-16F-46a, b, c, locality 11; pygidium, O. G. M. 105-16F-46d, locality 9.

ORYGMASPIS FIRMA Frederickson, n. sp.
Plate 71, figures 15–18

Cranidium convex axially, of moderate size; glabella convex, faintly keeled, tapering and with bluntly rounded front; three pairs of faint oblique glabellar furrows, first pair nearly obsolete, others becoming faint near dorsal furrow, none crossing glabella; occipital furrow straight and prominent at center, oblique and fainter at sides; occipital ring with median node; dorsal furrow deep

at sides and at anterior lateral angles of glabella, shallow across front. Brim equal in width to border, convex laterally but nearly flat in pre-glabellar area; border slightly convex, narrow at sides, widening at center and broadly pointed; marginal furrow broad, nearly straight. Fixed cheeks one-half width of glabella at midpoint; palpebral lobes large, essentially flat, located at middle of cranidium, faint ocular ridge. Posterior limbs elongate, four-fifths length of occipital ring, narrowly triangular; deep marginal furrow. Free cheeks unknown.

Facial suture cuts border at center and trends outward and backward around marginal furrow, then inward to palpebral lobe around which it curves, and then trends inward and outward in concave curve to posterior margin.

Remarks.—*O. firma* may be distinguished from *O. llanoensis* by the convex border, impressed marginal furrow, and more blunt glabella. In all other characters the two species are similar.

Occurrence.—Honey Creek formation (*Taenicephalus* subzone), Arbuckle and Wichita Mountains, localities 9, 11, and 14.

Holotype.—Cranidium, O. G. M. 105-16F-59; paratypes, cranidia, O. G. M. 105-16F-58, and specimen on slab with holotype; locality 14.

Genus PARABOLINOIDES Frederickson, n. gen.

Cranidium wider than long, narrowest across palpebral lobes. Glabella convex, elongate, tapering; three pairs of faint glabellar furrows; occipital ring with median node. Brim flatly convex, equal to or greater in width than convex, crescentic border. Fixed cheeks narrow, flat or slightly downsloping; palpebral lobes small, elevated on transverse flexure of cheek, located between first and second pair of glabellar furrows; faint ocular ridge. Posterior limbs broadly triangular with anteriorly bowed marginal furrow. Surface of cranidium smooth.

Pygidium wider than long, oval in outline; axial lobe in five segments, convex, slightly tapering to rounded posterior segment which extends nearly to flat posterior border; three pairs of pleural segments curving posteriorly and terminating in short, broad marginal spines; pleural furrows shallow.

Genotype.—*Parabolinoides contractus* Frederickson, n. sp.

Remarks.—*Parabolinoides* differs from *Bernia* in having a much flatter cranidium, a more flatly convex, longer, straighter-sided glabella, fainter glabellar furrows, a wide pre-glabellar area and a large flaring brim and border. *Parabolinoides* is quite similar to *Parabolinella* Brögger, but differs in having a more flaring brim and border, in the much wider border, and in the divergent course of the facial suture anterior to the palpebral lobes. Two species, both from the Honey Creek formation are included in the genus.

EXPLANATION OF PLATE 72

FIGS. *1, 2*—*Taenicephalus wichitaensis* Resser. *1*, Hypotype, small cranidium, ×5, O. G. M. 105-16F-50, loc. 11. *2*, Hypotype, average sized cranidium, ×3, O. G. M. 105-16F-44, loc. 15. (p. 362)

3–6—*Meeria lirae* Frederickson, n. sp. *3, 4*, Holotype; dorsal and profile views of cranidium of adult individual, ×2½, O. G. M. 105-16F-41, loc. 6. *5*, Paratype; cranidium of young individual, ×2½, O. G. M. 105-16F-40, loc. 6. *6*, Paratype; cranidium, X2½, O. G. M. 105-16F-42, loc. 6. (p. 358)

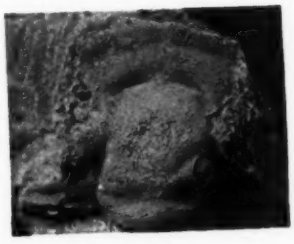
7–9—*Wilbernia pero* (Walcott). *7*, Hypotype, large exfoliated cranidium, ×2, O. G. M. 105-16F-39, loc. 6. *8, 9*, Hypotype, dorsal and profile views of cranidium, ×2, O. G. M. 105-16F-51, loc. 6. (p. 362)

10–12—*Idahoia ? longa* Frederickson, n. sp. *10, 11*, Holotype; dorsal and profile views of cranidium, ×2, O. G. M. 105-16F-168a, loc. 11. *12*, Paratype, fragmental cranidium, ×2, O. G. M. 105-16F-168b, loc. 11. (p. 358)

13–16—*Wilbernia expansa* Frederickson, n. sp. *13*, Holotype; cranidium, ×1½, O. G. M. 105-16F-169a, loc. 11. *14*, Paratype; fragmental cranidium, ×1½, O. G. M. 105-16F-169b, loc. 11. *15, 16*, Paratype; dorsal and profile views of large weathered, most complete cranidium, ×1½, O. G. M. 105-16F-52, loc. 6. (p. 362)

17—*Pseudagnostus josepha* (Hall). Hypotypes, slab with group of cephala and pygidia, ×10, O. G. M. 105-16F-53, loc. 11. (p. 362)

1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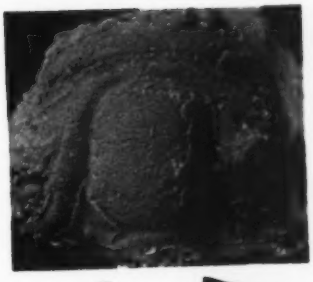
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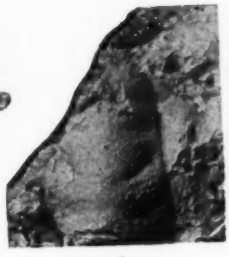
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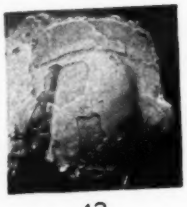
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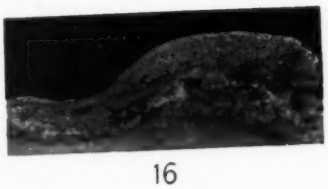
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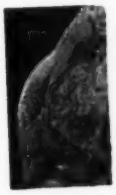
9

17

15

11

Frederickson, Upper Cambrian Trilobite Fauna

The new genus *Parabolinoides* includes specimens that have been referred to the genus *Maustonia* Raasch. Raasch (1939, p. 94) proposed the genus *Maustonia*, "to include *Conocephalites nasutus* Hall 1863," but neglected to publish either a summary of characters or a definite bibliographic reference, and therefore the name *Maustonia* is invalid under Article 25, paragraph c, of the International Rules of Zoological Nomenclature. Raasch also failed to observe that Resser (1937, p. 26) previously had assigned *Conocephalites nasutus* Hall to the genus *Taenicephalus*. Raasch's interpretation of the scope of *Maustonia* is evidenced by specimens which he identified with that genus. Subsequently, other workers in Upper Cambrian paleontology became familiar with *Maustonia*, and included that genus in published lists unaware of its invalidity. I do not consider *Conocephalites nasutus* Hall as a species of *Parabolinoides*, but several of the undescribed species present in Wisconsin and Minnesota, and probably elsewhere in Franconian horizons, undoubtedly will be referred to this genus.

PARABOLINOIDES CONTRACTUS
Frederickson, n. sp.
Plate 71, figures 4–10

Cranidium contracted across eyes giving hour-glass shape. Glabella convex, tapering slightly at sides, rounded in front; three pairs of oblique glabellar furrows not extending across glabella; occipital furrow faint and oblique at sides, deeper and bowed forward at center; occipital ring with small central node; dorsal furrow well marked at sides, becoming fainter in front of glabella with shallow anterior pits. Brim essentially flat in pre-glabellar area, flaring laterally from palpebral lobes at about same angle as posterior limbs; border equal in width to brim along axial line, tapering rapidly laterally, convex, raised; marginal furrow well marked along steep posterior portion of border. Fixed cheeks narrowest across eyes; palpebral lobes small, elevated on transverse flexure of cheek, located between first and second pair of glabellar furrows; faint ocular ridge. Posterior limbs broadly triangular; marginal furrow broad, slightly curved. Free cheek unknown.

Facial suture cuts anterior margin near center, curves outward and backward around marginal furrow, then trends inward to palpebral lobe around which it curves, then outward and backward in flat sigmoidal curve to posterior margin.

Pygidium wider than long, oval in outline; axial lobe in five segments, convex, slightly tapering to rounded posterior segment which extends nearly to flat posterior border; three pairs of pleural segments curving posteriorly and terminating in short, broad marginal spines; pleural furrows shallow.

Occurrence.—Honey Creek formation (*Eoorthis* subzone), Arbuckle Mountains, localities 15 and 16.

Holotype.—Cranidium, O. G. M. 105-16F-33a, locality 16; paratype, cranidia, O. G. M. 105-16F-33b, O. G. M. 105-16F-33c, locality 16; paratype, pygidium, O. G. M. 105-16F-37, locality 16.

PARABOLINOIDES HEBE Frederickson, n. sp.
Plate 70, figures 7, 8; Plate 71, figures 1–3

Cranidium wider across posterior limbs than long but narrow fixed cheeks and preglabellar area give impression of length. Glabella and occipital segment almost four-fifths length of cranidium; glabella flatly convex, tapering at the sides, rounded-truncate anteriorly; three pairs of very faint glabellar furrows; occipital furrow convex, widest at center, tapering at sides, with median node; dorsal furrow deeper at sides than across front of glabella; anterior pits at lateral angles of glabella. Brim flatly convex; border raised above brim, convex, broadly pointed, slightly more than two-thirds width of brim; marginal furrow follows contour of raised posterior portion of border. Fixed cheeks slightly convex, one-third glabellar width at midpoint; palpebral lobes small, located opposite glabellar lobe between first and second pair of furrows. Posterior limbs broadly triangular; marginal furrow bowed anteriorly. Free cheek unknown.

Facial suture cuts anterior border at center forming obtusely pointed border, trends laterally around marginal furrow, then very slightly inward to palpebral lobes, curves around them and trends in flat sigmoidal curve to posterior margin.

Remarks.—*Parabolinoides hebe* differs from

P. contractus in the straighter course of the facial suture anterior to the palpebral lobes, resulting in a much narrower anterior portion of the cranidium. In addition, the border is more pointed, somewhat narrower, and the ocular ridge straighter than in *P. contractus*.

Occurrence.—Honey Creek formation (*Eoorthis* subzone), Arbuckle and Wichita Mountains, localities 9, 14, 15 and 16.

Holotype.—Cranidium, O. G. M. 105-16F-36b; paratypes, cranidia, O. G. M. 105-16F-35, O. G. M. 105-16F-36a, O. G. M. 105-16F-57b, locality 16; paratype, cranidium, O. G. M. 105-16F-57a, locality 14.

Genus PSEUDAGNOSTUS Jaeckel, 1909
PSEUDAGNOSTUS JOSEPHA (Hall)
Plate 72, figure 17

Agnostus josepha HALL, 1863, 16th Annual Rep't., N. Y. State Cabinet Nat'l. Hist., p. 178, pl. 6, figs. 54, 55.
Pseudagnostus josepha (Hall) KOBAYASHI, 1935, Imp. Univ. Tokyo, Sec. II, vol. 4, pt. 2, p. 108.
Pseudagnostus josepha (Hall) KOBAYASHI, 1935, Imp. Univ. Tokyo, Sec. II, vol. 5, pt. 5, p. 157.
Pseudagnostus josepha (Hall) SHIMER and SHROCK, 1944, Index Fossils of N. Amer., p. 601, pl. 251, figs. 5, 6.

Remarks.—This species is abundant in the *Taenicephalus* zone in the upper portion of the Honey Creek formation and extends upward into the Ft. Sill formation. No complete specimens were found, although commonly a number of cephala and pygidia were grouped as if thrown together by the sorting action of waves and currents. Largest specimens measure: cephalon 3½ by 3½ mm., pygidium 3½ by 3½ mm.

Occurrence.—Honey Creek and Ft. Sill formations (*Taenicephalus* subzone and *Ptychaspis* zone), Arbuckle and Wichita Mountains localities 8, 9, 10, 11, 13, 15.

Hypotypes.—Small slab with group of cephala and pygidia, O. G. M. 105-16F-53, locality 11.

Genus TAENICEPHALUS Ulrich and Resser, 1924
TAENICEPHALUS WICHITAENIS Resser
Plate 72, figures 1, 2

Taenicephalus wichitaensis RESSER, 1942, Smithsonian Misc. Coll., vol. 103, no. 5, p. 105, pl. 21, figs. 13–17.

Remarks.—The main differences between *Taenicephalus wichitaensis* and *Taenicephalus shumardi* (Hall), the genotype, are the wider anterior portion of the cranidium, and the more nearly equal brim and border of the former. This species is extremely abundant throughout all exposures of the Honey Creek formation.

Occurrence.—Honey Creek formation, (*Taenicephalus* subzone), Arbuckle and Wichita Mountains, localities 8, 9, 10, 11, 13, 15 and 16.

Hypotypes.—Cranidia, O. G. M. 105-16F-44, locality 15; O. G. M. 105-16F-50 locality 11.

Genus WILBERNIA Walcott, 1924
WILBERNIA PERO (Walcott)
Plate 72, figures 7–9

Ptychoparia pero WALCOTT, 1890, Proc. U. S. Nat. Mus., vol. 13, p. 274, pl. 21, fig. 6.
Wilbernia pero (Walcott) WALCOTT, 1925, Smithsonian Misc. Coll., vol. 75, no. 3, p. 124, pl. 15, figs. 22, 23 (for synonomy to date).
Wilbernia pero (Walcott) SHIMER and SHROCK, 1944, Index Fossils of N. Amer., p. 635, pl. 266, figs. 20–22.

Remarks.—The Oklahoma specimens seem to be identical with the Texas species that Walcott chose as the genotype. The specimens illustrated were found in association with *Meeria lirae*.

Occurrence.—Upper Cambrian, Honey Creek formation (top of *Taenicephalus* subzone), Arbuckle and Wichita Mountains, locality 6.

Hypotypes.—Cranidia, O. G. M. 105-16F-39, O. G. M. 105-16F-51, locality 6.

WILBERNIA EXPANSA Frederickson, n. sp.
Plate 72, figures 13–16

Cranidium sigmoidally curved along axis as result of convex glabella and concave border. Glabella nearly rectangular, tapering slightly at sides, and bluntly rounded anteriorly; no apparent glabellar furrows; occipital furrow most distinct across center; occipital ring convex, narrow at sides. Brim very narrow, convex, cord-like in front of glabella; border very wide, concave; marginal furrow narrow, impressed, broadly curved forward in center and separated from dorsal furrow by narrow brim. Fixed cheeks more than one-third width of glabella at midpoint, nearly flat; palpebral lobes large, hemispheric, located behind glabellar midpoint; palpebral furrow faint but distinct;

ocular ridge extending to meet dorsal furrow at point one-third distance posteriorly from front of glabella. Posterior limbs narrow; furrow impressed.

Facial suture intramarginal to center of cranidium, trends laterally in convex curve around marginal furrow and continues inward to and around palpebral lobes and then outward and backward in sigmoidal curve to posterior border.

Remarks.—The new species, *Wilbernia expansa* Frederickson, resembles *Wilbernia pero* (Walcott), the genotype, in the shape and convexity of the glabella, the very poorly defined glabellar furrows, and the shape and position of the palpebral lobes. The pre-glabellar area of the cranidium is quite different from the genotype, however, The marginal furrow is narrower and nearly tangent with the dorsal furrow, and the border is large and concave as contrasted to the convex border of *Wilbernia pero.*

Occurrence.—Honey Creek formation, (upper *Taenicephalus* subzone), Arbuckle and Wichita Mountains, localities 6 and 11.

Holotype.—Cranidium, O. G. M. 105-16F-169a, locality 11; paratypes, cranidia, O. G. M. 105-16F-169b, locality 11; O. G. M. 105-16F-52, locality 6.

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JOURNAL OF PALEONTOLOGY, VOL. 23, NO. 4, PP. 364–379, PL. 73, JULY 1949

THE OSTRACODE GENUS *EUCYTHERURA* AND ITS SPECIES FROM THE CRETACEOUS AND TERTIARY OF THE GULF COAST

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ABSTRACT—Twelve new species of *Eucytherura* are described. History of the genus, and divergences from the original description by various authors are discussed. Check list, list of sample localities, generic and specific descriptions, and bibliography complete the paper.

INTRODUCTION

EUCYTHERURA is a common ostracode genus from the Cretaceous and Tertiary of the Gulf Province. It has been largely overlooked because of its small size. Heretofore only three species have been described from this region, *Eucytherura murdercreekensis* Howe and Law 1936, *Eucytherura chelodon* (Marsson) of Alexander 1936, and *Eucytherura claibornensis* Stephenson 1944. *Eucytherura chelodon* (Marsson) of Alexander 1936 appears to have been erroneously assigned to this genus.

The description of the shell characteristics of the genus is amplified by the description of twelve new species, *E. ansata*, *E. aspera*, *E. cribroreticulata*, *E. decorata*, *E. hiwanneensis*, *E. imporcata*, *E. latebrosa*, *E. mariannensis*, *E. oculata*, *E. stephensoni*, *E. strumosa*, and *E. tricornis*.

Types.—Holotypes and cotypes are deposited in the Henry V. Howe collection, School of Geology, Louisiana State University, Baton Rouge, La.

Acknowledgments.—Gratitude is expressed to Dr. Henry V. Howe, Dean of the College of Arts and Science, and Director of the School of Geology, Louisiana State University, for his guidance, suggestions, and help as well as for supplying the material from which the new species were described. The writer's study was made possible by a scholarship granted by the Creole Petroleum Corporation of Venezuela which enabled him to attend Louisiana State University.

HISTORY OF THE GENUS

The genus *Eucytherura* was established by G. W. Müller (1894, p. 305) on four Recent species from the Gulf of Naples. Three of these species were new and one had been described before (*Cythere complexa* Brady 1867, p. 210). Müller[1] gave the following discussion of the genus:

Carapace heavy, rather short, very short in front, cut off almost vertically, produced into a short point at the end. Among the species with which I became acquainted the profile is so similar that I renounced to reproduce it from all species (compare the description of *Eucytherura complexa*). The inner margin and the line of concrescence are difficult to see; one only succeeds in tracing the inner margin from the inside; it runs parallel to the shell margin and is moderately removed from it; the line of concrescence seems to coincide entirely with the inner margin. Radial pore canals are only very scattered. The fringe is narrow, entire, membranous, covered by the overtopping calcified lip. Lateral eyes are distinct, large, the middle eye small and cannot always be traced with certainty. Hinge line only with anterior and posterior tooth in the right valve, between these sometimes finely dentated. The first antenna is rather slim with six indistinct segments (the fourth and fifth segment are not sharply separated). Bristles are moderately long, partially as long as the last four segments and slim. A few are stronger developed. The second antenna has four segments. The mandible has a slim masticatory appendage which carries at its point a few long and pointed teeth. The palp has three segments, the first and second one of them are fused together. The branchial plate has one long and another very short bristle. The maxilla has slim masticatory appendages. The two mouthward directed rays of the branchial plate are almost equal in length. The first, second and third leg are long and slim, especially the end claw. The margin, a double bristle on the posterior margin of the first segment. The third leg with or without a bristle on the anterior margin

[1] All translations from the German of G. W. Müller, Lienenklaus, Van Veen and Bonnema given as quotations in the succeding pages have been made by the present writer and he believes correctly express what the authors intended.

and with one bristle on the posterior margin (the bristles on the anterior margin always without the one at the end of the first segment). Furca of the female with four bristles. The posterior end of the body is produced into a long and slim point.

As Müller pointed out above, the species he examined were all very similar in profile to the one he described as *Eucytherura complexa* (Brady) of Müller as follows:

Carapace in profile rather short and robust. Relation of height to length is 1:1.6. Dorsal margin straight, dropping somewhat towards the posterior end. Ventral margin straight as well. Anterior margin forms a very flat arch. It is set off sharply from the dorsal and ventral margins in an angle which is slightly larger than ninety degrees. The lower angle of the anterior margin lies a little anterior to the upper angle. The margin is overhung by a broad lip which has radial striae and some stronger ribs. The posterior end is set off sharply from the dorsal and ventral margins as well. Its lower angle lies distinctly in front of its upper angle. The posterior margin forms a more or less right angle with a blunt point which lies within two thirds of the height of the valve. It is surpassed as well by a calcified and striated lip.

Müller did not give any description of muscle scars but only mentioned them as an areal reference in the description of surface ornamentation. From that we can gather that the muscle scar area lies slightly anterior and below the center of the valve. The species recognized by Müller in 1894 are:

Eucytherura complexa (Brady) of Müller 1894, p. 306, pl. 20, figs. 13, 17; pl. 21, fig. 3; =? *Cythere complexa* Brady 1867, p. 210; =*Cythere limicola* (partim) Brady 1868, p. 405, pl. 31, figs. 38–41; =*Cythere complexa* Brady and Norman 1889, p. 145, pl. 19, figs. 31, 32.
Eucytherura angulata n. sp., p. 307, pl. 20, fig. 18.
Eucytherura alata n. sp., p. 307, pl. 20, fig. 20.
Eucytherura gibbera n. sp., p. 307, pl. 19, figs. 21–26; pl. 20, figs. 14, 16, 19; pl. 21, figs. 1, 2.

The legend of plate 29 (figs. 13, 17) reads *Eucytherura dilatata* erroneously instead of *Eucytherura complexa*. Under the synonomy of *Cythere complexa* Müller listed *Cythere limicola* (partim) Brady 1868, p. 405, pl. 31, figs. 38–41. The figures should correctly be 43–46. Both errors in the 1894 paper were corrected by Müller in his 1912 publication.

No genotype is designated in Müller's 1894 paper. *Eucytherura complexa* (Brady) of Müller (Plate II, fig. 1 in this paper) is the first one described in the text and the only one mentioned in the generic description. This might indicate it as genotype. Müller clearly showed, however, by his question mark in front of the genus that he was not completely sure whether his species corresponded exactly to *Cythere complexa* Brady 1867. On the other hand Müller may have intended *Eucytherura gibbera* to be the genotype because this is the species illustrated with most detail.

The next reference to the genus *Eucytherura* was made by Lienenklaus (1900, p. 544). This represents to the writer's best knowledge the first reference to fossil forms of the genus. Lienenklaus described two species from the Lower Oligocene of Lattorf, Eggersdorf and Wormiraleben in Germany. These species are: *Eucytherura macropora* p. 544 (=*Cytheropteron macroporum* Lienenklaus 1894, p. 246, pl. 17, fig. 4) and *Eucytherura echinata* n. sp., p. 544, pl. 22, fig. 7. Lienenklaus wrote as follows on the genus:

The valve is robust, short, truncated in front, projected into a short point at the posterior end. Dorsal and ventral margins are straight in a general sense. The surface is pitted or spiny. Inner margin, line of concrescence and pore canal cannot be recognized in fossil specimens and are according to Müller very difficult to trace in recent species as well.

In the discussion of his new species *Eucytherura echinata* he gave the following description of the hinge line:

The hinge of the left valve shows a delicate bar which is very finely crenulated. The hinge of the right valve has one small tooth at its anterior and at its posterior end.

Nothing is said about the eye in this paper. The figures of his two species do not show a distinct eye spot. Thus the question is raised whether these two species definitely belong to this genus.

Lienenklaus (1905, p. 47) reported one species, *Eucytherura dentata* n. sp. (pl. 4, fig. 31) from the Middle Oligocene of Offenbach, Germany. This particular species has later been assigned to *Loxoconcha* by Van den Bold (1946, p. 111, pl. 15, figs. 8a–e).

G. W. Müller (1909, p. 114–117) did not amplify his original 1894 generic description to which he referred. He reported two species from the Recent of the Antarctic. One of them is certain, *Eucytherura punctata* n. sp., p. 114, pl. 17, figures 2, 9, the other one uncertain, *Eucytherura? antarctica* n. sp. p. 115, pl. 16, figures 2, 8.

The genus was maintained by G. W. Müller (1912, p. 279) who cited five previously described species. These are: *Eucytherura angulata* Müller 1894, *Eucytherura gibbera* Müller 1894, *Eucytherura complexa* (Brady) of Müller 1894, *Eucytherura alata* Müller 1894 and *Eucytherura punctata* Müller 1909. In this paper Müller corrected the mistake in the legend to plate 20 of his 1894 publication (err.: *Eucytherura dilatata* instead of *Eucytherura complexa*). Under the synonomy of *Eucytherura complexa* he pointed out that *Cythere limicola* (partim) Brady, 1868, p. 405, pl. 31, figures 43–46 is not the same as *Cythere limicola* Norman 1865.

The following short discussion of the genus was given by Müller:

> Carapace robust with straight dorsal margin. Almost vertically inclined, slightly arcuate anterior margin. Posterior margin projected into a point which lies above half the height of the valve. Hinge only with anterior and posterior tooth in the right valve and sometimes finely crenulated between these teeth. Inner margin and line of concrescence coincide (always?) in their whole extent and run almost parallel to the outer margin.

Mehes (1936, p. 25) reported three new species and one new variety from the Eocene of the vicinity of Budapest, Hungary. The writer has been able to see only the plates and a short German resume of this paper which was originally written in Hungarian. Nothing in the resume amplifies the knowledge of *Eucytherura*. The species cited are: *Eucytherura depressa* n. sp., p. 25, pl. 3, figures 5–8; *Eucytherura hungarica* n. sp., p. 26, pl. 3, figures 9–11; *Eucytherura hantkeni* n. sp., p. 27, pl. 3, figures 13, 14 and *Eucytherura hantkeni*, var. *rara* n. var., p. 28, pl. 3, figures 17, 18.

Only *Eucytherura depressa* may possibly be a true *Eucytherura* judging by the figures.

Howe and Law (1936, p. 71) described one new species from the Byram marl of Mississippi and Alabama. This species is *Eucytherura murdercreekensis* (p. 71, pl. 4, fig. 31; pl. 5, fig. 26). They give no special discussion of the genus but stated under the description of their new species that

> the hinge of the right valve has a small, prominent rounded tooth at either cardinal angle. Between these points the dorsal margin is straight and bears a distinct groove.

This description of the hinge line agrees fully with Müller's (1894, p. 305) original generic description.

Alexander (1936, p. 692) was the first to designate *Cythere complexa* Brady 1867 (p. 210) as the genotype of *Eucytherura*. The following is said about the genus in this paper:

> Small Ostracoda, with relatively thick and heavy shells. Carapace in side view short, quadrate. Dorsal margin straight or very slightly irregular. Ventral margin straight or slight-convex, roughly paralleling the dorsal margin. Anterior end bluntly rounded, in many species almost squarely truncated. Posterior end produced to form a short, compressed caudal process. Müller describes the hinge structure as consisting of "anterior and posterior teeth in the right valve." The hinge structure of the Cretaceous species referred to this genus, *Eucytherura chelodon* (Marsson), is indistinguishable from that of *Cythereis*. Inner margin and line of concrescence coincide throughout and run parallel to, and at a moderate distance from, the outer margin of the shell. Radial pore canals few in number, isolated from each other, simple, straight or slightly irregular in their course.

This very complete and detailed description of the shell characteristics of *Eucytherura* does not agree, however, with Müller's original description of the hinge line indistinguishable from that of *Cythereis*. The diverging description of the hinge line caused later authors to assign species to the genus *Eucytherura* which actually should not have been placed there. The species described in Alexander's (1936, p. 692) paper and its synonymy was: *Eucytherura chelodon* Alexander, p. 692, pl. 93, figures 6, 12 (= *Cythere chelodon* Marsson 1880, p. 43, pl. 3, figs. 13a–f; = *Cytherura? dubia* Israelsky 1929, p. 6, pl. 4A, fig. 6) from the Cretaceous Lower Brownstown clays of Texas.

The present writer has not had the opportunity to examine specimens of *Cythere chelodon* (Marsson) of Alexander. He has examined, however, *Cytherura? dubia* Israelsky from the Henry V. Howe collection of the Saratoga chalk. This latter species definitely does not appear to be an *Eucytherura*. Its hinge structure is much closer related to the hinge of *Cytherura*. Van Veen (1938, p. 17) stated that the valve figured by Alexander (1936, p. 692, pl. 93, figs. 6, 12) is from a species closely related to *Cythere chelodon* Marsson. Bonnema (1941,

p. 21) observed that he has been able to examine species from the Marsson collection which is kept in Berlin. These, he stated, agree with the specimens from the Maastricht Chalk of South Limburg but not with the valve figured by Alexander (1936). Thus the species described by Alexander (1936, p. 692) appears to be different from *Cythere chelodon* Marsson.

Van Veen (1938, p. 16) assigned ten species from the Upper Cretaceous of South Limburg to the genus *Eucytherura*. She based her determinations on Alexander's paper (1936) and thus followed his concept of the *Eucytherura* hinge line being indistinguishable from that of *Cythereis*. Thus we see that some species assigned to *Eucytherura* have a hinge structure definitely different from the one given in Müller's (1894) original generic description. This is illustrated by Van Veen's (1938, p. 16) statement:

> Furthermore it should be mentioned that we as well found from our material that the number of teeth of the hinge of the left valve is different. In most cases they seem to be absent, such as in the case of those described by Müller (1894, p. 305). *Eucytherura chelodon* (Marsson 1880, p. 43) and closely related species of *Cytherura* have a tooth behind the anterior socket of the left valve. Sometimes there occur two teeth, one behind the anterior socket and another one in front of the posterior socket. This is the case with *Eucytherura marssoni* n. sp. (No. 4 Van Veen 1936, p. 179, pl. 10, figs. 42–44), *Eucytherura cretacea* n. sp. (No. 5 Van Veen 1936, p. 179, pl. 10, figs. 45–48) and *Eucytherura tuberculifera* n. sp. (No. 6 Van Veen 1936, p. 179, pl. 10, figs. 49–51). About the hinge of *Eucytherura furcifera* n. sp. (No. 7 Van Veen 1936, p. 179, pl. 10, figs. 52–54 we cannot say anything since we only had specimens with a complete carapace at our disposal.

The other species cited in Van Veen's paper are:

Eucytherura chelodon (Marsson), p. 17; = *Cythere chelodon* Marsson 1880, p. 43, pl. 3, figs. 13 a–f; = *Cythereis elegans* p.p. Van Veen 1936, p. 145, pl. 4, fig. 61, pl. 5, figs. 1, 2.

Eucytherura simplex n. sp., p. 17; = *Cythereis pulchella* p. p. Van Veen 1936, p. 148, pl. 5, fig. 13.

Eucytherura plana n. sp., p. 17; = No. 1 Van Veen 1936, p. 178, pl. 10, figs. 31–33.

Eucytherura bicornis n. sp., p. 17; = No. 2 Van Veen 1936, p. 178, pl. 10, figs. 34–36.

Eucytherura squamifera n. sp., p. 17; = No. 3 Van Veen 1936, p. 178, pl. 10, figs. 37–41.

Eucytherura dorsotuberculata n. sp., p. 17; = No. 8 Van Veen 1936, p. 179, pl. 10, figs. 55–57.

Van Veen described the hinge line of the last five species as follows: "Hinge of the right valve carries one tooth at its anterior and one tooth at its posterior end. The left valve has no teeth." This agrees with Müller's (1894) original description. Thus we consider these last five species to be good *Eucytherura* while the assignment of Van Veen's other five species to this genus appears incorrect.

Bonnema (1941, p. 21) reported thirteen species of the genus *Eucytherura*—eleven of them new—from the subsurface Cretaceous of the northeastern Netherlands. No discussion of the genus is given in this paper. According to the descriptions and figures the following of Bonnema's species appear to be good *Eucytherura:*

Eucytherura dorsotuberculata Van Veen 1938 of Bonnema 1941, p. 21, pl. 5, figs. 42–44.

Eucytherura dorsotuberculatoides n. sp., p. 21, pl. 5, figs. 45–46.

Eucytherura ventrotuberculata n. sp., p. 21, pl. 5, figs. 47–51.

Eucytherura tuberculata n. sp., p. 21, pl. 5, figs. 52–57.

Eucytherura tumida n. sp., p. 22, pl. 5, figs. 69–77.

Eucytherura mulleri n. sp., p. 22, pl. 5, figs. 78, 79.

Eucytherura longa n. sp., p. 22, pl. 5, figs. 80–83.

Eucytherura contracta n. sp., p. 22, pl. 5, figs. 84–87.

Eucytherura longicauda n. sp., p. 24, pl. 5, figs. 95–103.

Two other species may possibly belong to this genus as nothing definite was said about their hinges by Bonnema, however. These are:

Eucytherura latifrons n. sp., p. 22, pl. 5, figs. 88–94.

Eucytherura humilis n. sp., p. 24, pl. 5, figs. 104–106.

Eucytherura chelodon (Marsson) of Van Veen (1938, p. 17) and of Bonnema (1941, p. 21, pl. 5, figs. 58–59) should not have been placed in this genus for reasons previously discussed in this paper. Neither should *Eucytherura aculeata* n. sp., p. 21, pl. 5, figs. 60–68 have been placed here considering the description Bonnema gave of its hinge:

> The valves of young forms have two laterally compressed crenulated teeth on the right valve and none on the left one, while on adult forms the left valve carries a hunch-like tooth at the anterior end of the hing as well.

Bonnema (1941) noted a distinct sexual dimorphism in four of his new species.

Stephenson (1944, p. 453) reported one new species, *Eucytherura claibornensis* (pl.

Table 1. Checklist of Cretaceous and Tertiary Species of *Eucytherura* from the Gulf Province

Locality numbers:	Comanchean		Midway					Claiborne			Jackson		Red Bluff	Vicksburg			Calvert
	1	2 3	4	5	6	7	8	9	10	11 12	13	14	15	16	17	18 19	20
Eucytherura ansata n. sp.	x	x															
Eucytherura aspera n. sp.										x x							
Eucytherura claibornensis Stephenson								x									x
Eucytherura cribroreticulata n. sp.						x							x				
Eucytherura decorata n. sp.		x															
Eucytherura hivanneensis n. sp.					x		x							x	x	x	
Eucytherura imporcata n. sp.				x													
Eucytherura latebrosa n. sp.																	
Eucytherura mariannensis n. sp.																	
Eucytherura murdercreekensis Howe and Law																	
Eucytherura oculata n. sp.																	
Eucytherura stephensoni n. sp.																	
Eucytherura strumosa n. sp.																	
Eucytherura tricornis n. sp.																	

76, fig. 16), from the Reklaw Eocene of Texas. He did not discuss the genus but stated in his specific description that the hinge structure is similar to that in the genus *Cythereis*.

Stephenson (1946, p. 316) in his paper on Weches Eocene Ostracoda from Smithville, Texas stated that the holotype of *Eucytherura claibornensis* from the Reklaw Eocene of Texas was a broken right valve which did not show the characteristics of the posterior end. He redescribed the hinge line from two entire right valves from the Weches (pl. 43, fig. 19).

> The hinge line of the right valve bears small knob-like teeth at the cardinal angles. A narrow groove between them is almost imperceptibly crenulated. A slender bar defines the groove dorsally.

The writer had the opportunity to examine Stephenson's holotype No. 2397 of *Eucytherura claibornensis* from the Reklaw and his hypotype No. 3352 from the Weches of Texas. The hypotype differs sufficiently from the holotype to justify a new specific description. This hypotype was used by the writer as a paratype for a new species described in this paper (*Eucytherura stephensoni* n. sp.).

Van den Bold (1946, p. 35) did not report any species of *Eucytherura* but says the following about the genus:

> Carapace small, shell heavy and thick. Carapace subquadrangular, dorsal margin straight. Anterior end very broadly rounded, posterior end projecting in a subdorsal caudal process. Hinge structure as in *Cythereis*. Inner margin and line of concrescence coincide. Radial pore canals few, straight or slightly irregular. Cretaceous to Recent.

Van den Bold cited *Cythere complexa* Brady 1867 as genotype.

Summarizing, we can place all species so far assigned to *Eucytherura* in one or another of three groups.

Species considered to be good *Eucytherura:*

Eucytherura complexa (Brady 1867)
Eucytherura angulata Müller 1894
Eucytherura alata Müller 1894
Eucytherura gibbera Müller 1894
Eucytherura punctata Müller 1909
Eucytherura murdercreekensis Howe and Law 1936
Eucytherura simplex Van Veen 1938
Eucytherura plana Van Veen 1938

Eucytherura bicornis Van Veen 1938
Eucytherura squamifera Van Veen 1938
Eucytherura dorsotuberculata Van Veen 1938
Eucytherura dorsotuberculatoides Bonnema 1941
Eucytherura ventrotuberculata Bonnema 1941
Eucytherura tuberculata Bonnema 1941
Eucytherura tumida Bonnema 1941
Eucytherura mülleri Bonnema
Eucytherura longa Bonnema 1941
Eucytherura contracta Bonnema 1941
Eucytherura longicauda Bonnema 1941
Eucytherura claibornensis Stephenson 1944

Species questionably referred to this genus:

Eucytherura macropora (Lienenklaus 1894)
Eucytherura echinata Lienenklaus 1900
Eucytherura? antarctica Müller 1909
Eucytherura depressa Mehes 1936
Eucytherura furcifera Van Veen 1938
Eucytherura latifrons Bonnema 1941
Eucytherura humilis Bonnema 1941

Species erroneously assigned to *Eucytherura:*

Eucytherura dentata Lienenklaus 1905
Eucytherura hungarica Mehes 1936
Eucytherura hantkeni Mehes 1936
Eucytherura hantkeni var. *rara* Mehes 1936
Eucytherura chelodon of Alexander 1936 (non *Cythere chelodon* Marsson 1880)
Eucytherura chelodon (Marsson 1880) of Van Veen 1938
Eucytherura marssoni Van Veen 1938
Eucytherura cretacea Van Veen 1938
Eucytherura tuberculifera Van Veen 1938
Eucytherura aculeata Bonnema 1941

LIST OF LOCALITIES

1. Alexander's Station No. 25 (Alexander, C. I., 1929, Ostracoda of the Cretaceous of North Texas: *University of Texas Bull.*, No. 1907, p. 28); Tarrant County, lower part of Weno formation.
2. Alexander's Station No. 34 (Alexander 1929, p. 33); Denton County, Grayson formation; from horizon just below the third lime below the top of exposure.
3. Alexander's Station No. 34 (Alexander 1929, p. 33); Denton County, Grayson formation; from second lime below the top of the exposure.
4. Plummer's Station No. 46 (Plummer, H. J., 1926, Foraminifera of the Midway Formation in Texas: *University of Texas Bull.* No. 2644, p. 56); Clay pit, Mexia Brick Works, about 1 mile west of the town of Mexia.
5. Naheola Landing on Tombigbee River, secs. 30 or 31, T 15 N, R 1 E, Choctaw County, Ala. (Type locality of Naheola formation, Midway.)
6. Matthews Landing, Ala. On Alabama River, northern part of sec. 12, T 12 N, R 6 E, 6 miles west of Camden and 2½ miles above Clifton Ferry (Naheola formation).
7. Naheola (Midway), ¼ mile west of Rosebud, Ala. on highway 10 to Camden.
8. Coal Bluff (Midway); 29-11N-10E; Wilcox County, Ala. Collected by F. S. MacNeill.
9. Stephenson's locality, sample C (Stephenson, M. B., 1944, Ostracoda from the Reklaw Eocene of Bastrop County, Texas: *Jour. Paleontology*, vol. 18, no. 5, p. 448).
10. Stephenson's Locality 6, sample 4 (Stephenson, M. B., 1946, Weches Eocene Ostracoda from Smithville, Texas: *Jour. Paleontology*, vol. 20, no. 4, p. 301).
11. Cook Mountain formation; SE¼ NE¼ NE NE¼; 22-10N. 5E; Winn Parish, La. Collected by J. Huner, Jr.
12. Columbus, La. On the Sabine River behind Speight's Residence; Blue clay and limestone boulders (Claiborne); collected by J. B. Garrett.
13. 10 feet above base of Moody's Marl (Jackson, Eocene), Tullos, La., Collected by H. N. Fisk.
14. Hyson Bluff (Jackson) on Ouachita River, Caldwell Parish, La. At an elevation of 112 feet above river level.
15. Red Bluff (Oligocene), Hiwannee, Wayne County, Miss. 10 feet above *Balanophyllia* bed on the east bank of Chickasawhay River. Collected by Henry V. Howe.
16. Marianna Limestone (Oligocene), NE¼ 26-9N-7W, Wayne County, Miss.
17. Howe and Law's locality 11 (Howe and Law 1936, p. 13) Byram marl, 4½ miles southwest of Sylverina, Smith County, Miss. Collected by B. W. Blanpied.
18. Howe and Law's locality 14a (Howe and Law 1936, p. 13) Basal Byram marl on Murder Creek near Castleberry, Ala. Collected by B. W. Blanpied.
19. Howe and Law's locality 14b (Howe and Law 1936, p. 13) Upper Byram marl on Murder Creek near Castleberry, Ala. Collected by B. W. Blanpied.
20. Calvert formation; 16 feet above base at 1 mile south of Plum Point on the west side of Chesapeake Bay. Collected by R. J. Russell (No. 16) on December 31, 1934.

SYSTEMATIC DESCRIPTIONS

Order OSTRACODA Latreille
Suborder PODOCOPA Sars
Family CYTHERIDAE Baird, 1850
Genus EUCYTHERURA Müller, 1894

Eucytherura MÜLLER, G. W., 1894, Fauna und Flora des Golfes von Neapel, Mon. 21, Ostracoden, p. 305.
Eucytherura LIENENKLAUS, E., 1900, Die Tertiar-Ostrakoden des mittleren Norddeutschlands: *Zeits. Deutsch. geol. Gessell.* Bd. 52, p. 544.
Eucytherura MÜLLER, G. W., 1912, *Das Tierreich*, L. 31, Ostracoda, p. 279.
Eucytherura ALEXANDER, C. E., 1936, Ostracoda of the genera *Eucythere*, *Cytherura*, *Eucytherura*, and *Loxoconcha* from the Cretaceous of

Texas: *Jour. Paleontology*, vol. 10, no. 8, p. 692.

Eucytherura VAN VEEN, J. E., 1938, Die Ostracoden in der Tuffkreide ohne gelbe limonitische Färbung unter dem Koprolithenschichtchen zu Slavante: *Natuurhistorisch Maandblad*, 27e Jrg., nos. 1–2, p. 16.

Eucytherura VAN DEN BOLD, W. A., 1946, Contribution to the study of Ostracoda with special reference to the Tertiary and Cretaceous microfauna of the Caribbean region: Drukkerij en Uitgeverij J. H. de Bussy, Amsterdam, p. 35.

Genotype: *Cythere complexa* BRADY, G. S., 1867, Report on the Ostracoda dredged amongst the Hebrides: *Rept. British Assoc. Adv. Sci.*, p. 210 (genotype designated by Alexander, 1936); = *Cythere limicola* (partim) Norman 1865), 1868, p. 405, pl. 31, figs. 43–46; = *Cythere complexa* of Brady and Norman, 1889, p. 145, pl. 19, figs. 31, 32.

Carapace small, heavy and relatively thick. In side view subovate to subquadrate. Dorsal margin straight, ventral outline slightly convex and more or less converging towards the posterior end with dorsal margin. Ventral margin straight, commonly obscured by out-bulging ventral portion of carapace. Anterior end generally squarely truncated or bluntly rounded. Posterior end compressed and always produced into a point which lies in the upper half of the valve. Greatest height in the anterior half of the valve, greatest thickness close to the venter usually near the middle of the ventral outline. Prominent, generally glassy, eye spot close to the anterior cardinal angle. In exceptional cases heavy reticulate surface ornamentation may obscure the eye spot. Surface very ornate with reticulate pattern either of pits or tubercles, or both. Viewed from the inside valves are relatively deep. Marginal area broad and crossed by few, generally indistinct, simple radial pore canals. Inner margin runs approximately parallel to outer margin but departs sometimes farther from it around anterior and posterior ends. Line of concrescence cannot always be traced clearly. It generally appears to coincide with the inner margin throughout but may depart from it at the anterior and posterior ends. Normal pore canals are numerous.

The muscle scar pattern is made up of five scars. An almost vertical, slightly backwardly inclined row of four horizontally elongated scars lies somewhat ahead and below the center of the valve. A larger, kidney-shaped scar lies ahead of the row of four. It is vertically elongated and its convex portion points backwards. The hinge structure of the right valve is formed by an anterior small button-shaped tooth on the anterior cardinal angles, a posterior small round tooth which is slightly behind the posterior cardinal angle, and a straight groove which in most cases is almost imperceptibly crenulated. Hinge of the left valve consists of a round socket at the anterior cardinal angle, another round socket just behind the posterior cardinal angle and a generally very finely crenulated straight bar between them. Sockets open interiorly and form more or less prominent vertical hinge ears. In most cases the anterior hinge ear is more pronounced. Nothing definite can be said about the sexual dimorphism of this genus because of the small number of specimens known in any species. In only one species, *Eucytherura mariannensis* n. sp., has sexual dimorphism been suspected. It agrees with that described by Bonnema (1941) who observed definite sexual dimorphism in four out of thirteen species.

EUCYTHERURA ANSATA Weingeist, n. sp.
Plate 73, figures 1, 2, 4–7

Carapace very small, laterally compressed and relatively heavy. Elongate in lateral view. Dorsal margin straight and flattened. Ventral outline slightly convex, flattened and converging with the dorsum posteriorly. Anterior end broadly and evenly rounded. Three small more or less prominent teeth are on the lower half of the anterior margin. Posterior end compressed and produced into caudal process. The pointed end lies slightly above half the height of the valve. The upper portion of the posterior end is shorter than the more inclined and longer lower portion with which it forms a right angle approximately. Both the anterior and the posterior end form a distinct angle with the dorsal margin. The body of the carapace is ornamented by a complex series of tubercles and an irregular series of tiny knob-like swellings. The latter ones can be observed only in well preserved specimens. There are four tubercles along the dorsal outline. With exception of the one which is closest to the posterior cardinal angle, all are more

or less rounded. The first tubercle which lies slightly behind the anterior cardinal angle represents a prominent eye spot. The second tubercle, which is always the smallest, and the third are sometimes slightly pointed. The fourth dorsal tubercle is somewhat vertically elongated. A more or less prominent ridge extends diagonally across the upper half of the anterior end from the eye tubercle to slightly above the middle of the anterior margin. A distinct crescent-shaped blade-like ridge lies above the lower half of the anterior margin. Another sharp ridge extends from the anterior ventral angle along the venter as far back as another tubercle located above the center of the ventral margin. This tubercle is more or less distinct in different specimens. A prominent double tubercle lies close above the postero-ventral angle. A blunt ridge extends almost vertically from the posterior cardinal angle towards the venter. A slight swelling somewhat ahead and below the center of the valve indicates the muscle scar area. The greatest height of the valve lies in its anterior one-fifth. The greatest thickness is close to the middle of the venter. Viewed from the inside the valves are relatively deep. Marginal area broad, widest around the anterior and posterior ends. The relation of the line of concrescence to the inner margin is not recognizable. The inner margin runs approximately parallel to the outer margin. Radial pore canals, few in number, simple, hardly discernible on the anterior and posterior marginal areas. Normal pore canals appear to end in tiny knob-like projections on the surface. They vary from seven to seventeen in number. Muscle scar pattern and hinge structure as given under generic description in this paper. Vertical hinge ears are very pronounced in the left valve. The posterior hinge ear is relatively less prominent.

Dimensions of Holotype No. 4001, a right valve, from Locality 1: length, 0.28 mm.; height, 0.14 mm. Paratype No. 4002, a left valve, from Locality 1: length, 0.27 mm.; height, 0.15 mm.

Remarks.—This is a very common form from the Comanchean (Localities 1 and 2) of Texas. It exhibits numerous variations in the form of its surface ornamentation and represents perhaps more than one species. It is believed best, however, to consider them a single species because of the difficulty involved in separating them. *Eucytherura ansata* n. sp. is similar to *Eucytherura dorsotuberculata* Van Veen (1938). It departs from it, however, in the different arrangement and shape of the dorsal tubercles. *Eucytherura ansata* has these four tubercles equidistantly spaced from each other. In *Eucytherura dorsotuberculata* the first three tubercles are equally spaced while the fourth one is farther removed from the others. *Eucytherura ansata* is likewise similar to *Eucytherura tuberculata* Bonnema 1941. It differs from the European species in its more evenly rounded anterior end and in being much more compressed laterally.

EUCYTHERURA ASPERA Weingeist, n. sp.
Plate 73, figure 11

Carapace very small, relatively heavy. In side view elongate, sub-pentagonal, divided into two halves by a strong vertical depression along the middle of the valve. Dorsal outline appears ragged because of surface ornamentation. Straight dorsal margin obscured by dorsal portion of carapace. Ventral outline slightly convex and obscuring ventral margin which converges with dorsum towards posterior end. Ventral margin has slight concave central reentrant. Anterior end almost squarely truncated. Anterior cardinal angle lies posterior to antero-ventral angle. Anterior margin proper rounded broadly. It has some radial ridges and three to four teeth on the lower half. Posterior end compressed and extended as a caudal process with the blunt point lying in the upper third of the valve.

Both the anterior and posterior end form a rather pronounced angle with the dorsal outline. Greatest height in anterior one third of valve. Greatest thickness in posterior half of valve, close to the venter. There is a prominent eye spot near the anterior cardinal angle. Surface of carapace ornamented by a very indistinct pattern of angular pits. These are separated from each other by a network of fine ridges and short spines. The spines are mostly concentrated towards the dorsal portion of the carapace giving it a very ragged appearance. Along the middle of the dorsal outline

these spines become more prominent forming somewhat vertically elongated ridges. A narrow fringe of the anterior end and the entire posterior end are devoid of surface ornamentation. The anterior half of the carapace has a pronounced mound-like swelling just ahead and below the center of the valve. There is a backward projected pointed alar swelling just above the postero-ventral angle. A less prominent somewhat blade-edged swelling lies above the posterior cardinal angle. A fine but distinct ridge extends from above the antero-ventral angle along the ventrum towards the posterior angle. Viewed from the inside the valve is relatively deep. The reticulate pattern of ornamentation is more distinct. The marginal area is broad and crossed by very few distinct, simple and straight radial pore canals. The line of concrescence appears to depart slightly from the inner margin around the anterior and posterior ends. Normal pore canals are rather indistinct but one seems to end in each individual pit of the surface pattern. Only the hinge of the left valve could be studied. This agrees with the typical *Eucytherura* hinge line. Vertical hinge ears are present, the anterior one being more pronounced.

Dimensions of Holotype No. 4003, a left valve, from Locality 12: length, 0.28 mm.; height, 0.16 mm.

Remarks.—This species is based upon three well preserved left valves from Locality 12 and one complete carapace from Locality 11. It appears sufficiently distinctive to justify description.

Eucytherura cribroreticulata
Weingeist, n. sp.
Plate 73, figures 19, 22

Carapace heavy, relatively large for this genus. In lateral view subovate. Dorsal margin straight, ventral outline slightly convex and converging with the dorsal margin towards the posterior end. Dorsal outline coincides in lateral view with dorsal margin. Ventral portion of carapace projects over ventral margin obscuring it. Anterior end evenly rounded in a flat arch. A narrow lip projects slightly over the anterior margin in both valves. Posterior end somewhat compressed and produced into a blunt point which lies in the upper half of the valve. Carapace almost uniform in height. Greatest thickness just behind the middle of ventral outline. Exterior surface of carapace decorated with prominent subangular pits which make it appear like a sieve. The pits are very deep and separated by a network of fine ridges. This reticulate pattern may be easily seen from the inside. Each individual pit has several fine holes which represent

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Explanation of Plate 73
(All figures about ×90)

Figs. *1, 2, 4–7*—*Eucytherura ansata* Weingeist, n. sp. *1, 4*, right valves, locality 2; *2*, dorsal view of complete carapace; *5*, interior of a left valve, locality 2; *6*, paratype, left valve; *7*, holotype, a right valve showing muscle scar pattern. (p. 370)

3, 8—*Eucytherura stephensoni* Weingeist, n. sp. *3*, dorsal view of holotype, a complete carapace; *8*, right valve of holotype. (p. 376)

9—*Eucytherura decorata* Weingeist, n. sp. Holotype, a left valve. (p. 373)

10—*Eucytherura hiwanneensis* Weingeist, n. sp. Holotype, a left valve. (p. 374)

11—*Eucytherura aspera* Weingeist, n. sp. Holotype, left valve. (p. 371)

12, 21—*Eucytherura strumosa* Weingeist, n. sp. *12*, Holotype, a right valve; *21*, another right valve, locality 3. (p. 377)

13—*Eucytherura imporcata* Weingeist, n. sp. Holotype, a left valve. (p. 374)

14, 17—*Eucytherura latebrosa* Weingeist, n. sp. *14*, Holotype, a right valve; *17*, paratype, interior of a left valve. (p. 375)

15—*Eucytherura complexa* (Brady) of Müller (after G. W. Müller, 1894), left valve.

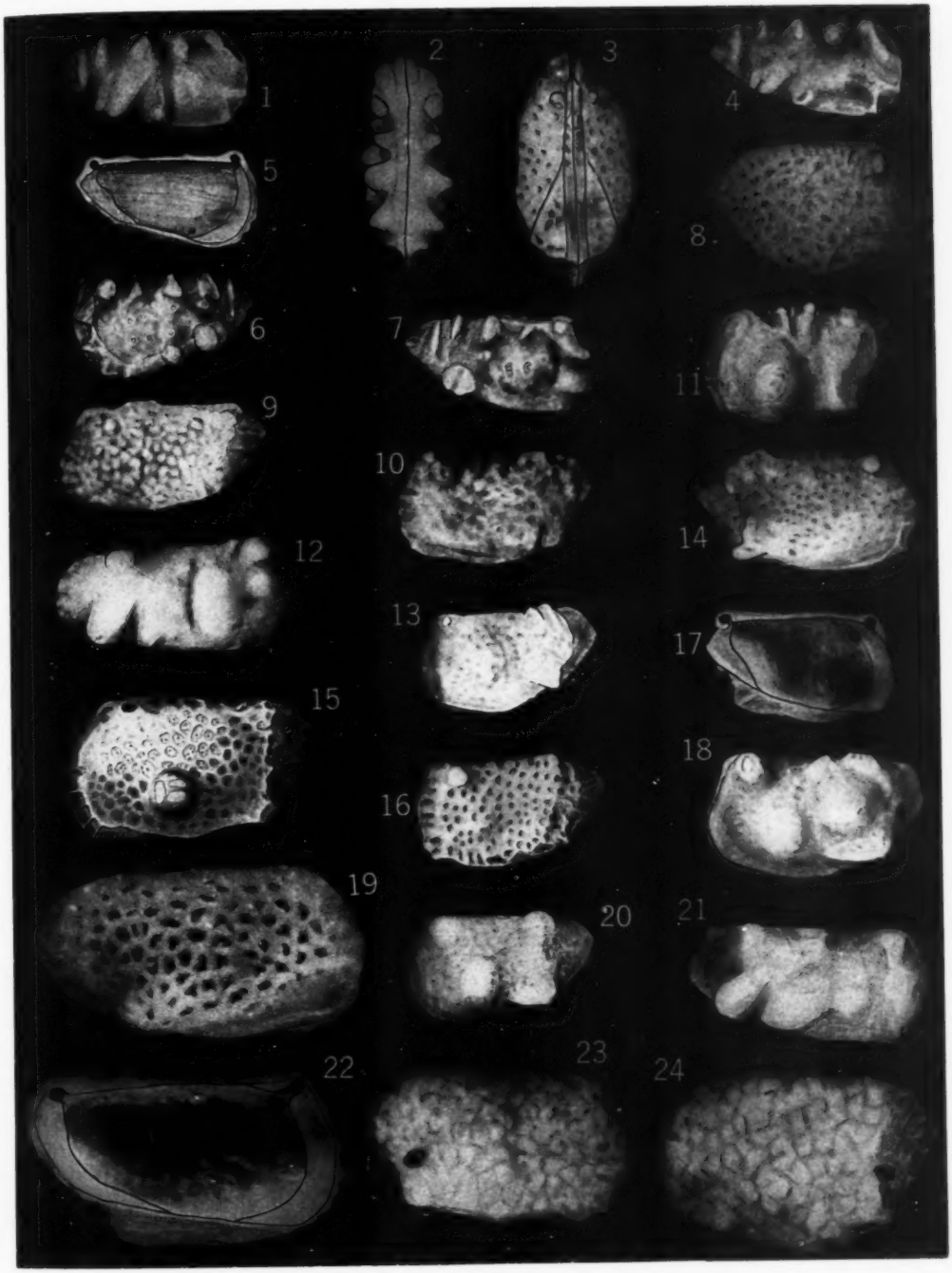
16—*Eucytherura murdercreekensis* Howe and Law; a left valve from locality 19.

18—*Eucytherura oculata* Weingeist, n. sp. Holotype, a left valve. (p. 376)

19, 22—*Eucytherura cribroreticulata* Weingeist, n. sp. *19*, cotype, right valve; *22*, cotype, interior of left valve. (p. 372)

20—*Eucytherura tricornis* Weingeist, n. sp. Holotype, a left valve. (p. 378)

23, 24—*Eucytherura mariannensis* Weingeist, n. sp. *23*, cotype, male right valve; *24*, cotype, female left valve. (p. 375)



Weingeist, Ostracode Genus *Eucytherura*

normal pore canals. A prominent alar backwardly deflected swelling lies just above and ahead of the postero-ventral angle. A faint sharp ridge extends from below this alar projection forward as far as the antero-ventral angle. Viewed from the inside the valves are deep. The marginal area is broad and widest around the anterior and posterior ends. Radial pore canals few in number, indistinct and simple. Line of concrescence coincides with the inner margin except for a short stretch close to the middle of the anterior and posterior ends. A distinct depression corresponding to the eye spot can be seen from the inside. No prominent eye spot appears on the surface of the carapace, where it is apparently obscured by the heavy reticulate ornamentation. Hinge structure typical of *Eucytherura*. The straight groove on the right valve and the straight hinge bar on the left valve are quite perceptibly crenulated. Hinge ears are only very slightly pronounced in the left valve.

Dimensions of Cotype No. 4004, a right valve, from Locality 20: length, 0.50 mm.; height, 0.26 mm. Cotype No. 4005, a left valve, from Locality 20: length, 0.49 mm.; height, 0.25 mm.

Remarks.—This species is known only from the Miocene (Locality 20). It is very distinctive and one of the largest species of the genus.

EUCYTHERURA DECORATA Weingeist, n. sp.
Plate 73, figure 9

Carapace very small, relatively heavy. In lateral view elongate. Dorsal margin straight, partially obscured by dorsal outline of carapace. Ventral outline slightly convex, hiding ventral margin. This is almost straight and converges with the dorsum posteriorly. Anterior end truncated but broadly rounded Anterior cardinal angle is set backwards in comparison with antero-ventral angle. Anterior margin appears thickened and crossed radially by three ridges which make its outline appear indented. Posterior end compressed and produced into a blunt point which lies in the upper one third of the valve. The upper and shorter portion of the posterior end is slightly concave. The lower and longer portion is straight. The valve is rather even in height between the anterior and posterior ventral angles. The greatest thickness lies close to the postero-ventral angle. There is a very distinct glassy eye spot close behind the anterior cardinal angle. The surface of the carapace is ornamented by very distinct angular pits separated from each other by a reticulate pattern of fine ridges. One normal pore canal ends in each individual pit. The anterior and posterior ends are devoid of surface ornamentation. A faintly depressed area extends through the central portion of the valve towards the venter. Above the postero-ventral angle lies a backward deflected ragged alar projection which is clearly double in ventral view. A sharp ridge extends from above the antero-ventral angle backwards as far as the middle of the ventral outline. It is curved upwards at its anterior end. Another ridge begins somewhat above the end of the anteriorly mentioned one and extends backwards to the postero-ventral angle. A small but conspicuous spine-shaped projection lies at the end of the centrally depressed area close to the venter. A blunt ridge runs along the dorsal edge from above the ocular spot to the middle of the dorsum. Another one is more or less a continuation of the former. It is farther removed from the dorsal outline, however, and extends from the middle of the dorsum towards the posterior cardinal angle. This ridge is convex upwardly, indented and thickening towards its posterior end. Viewed from the inside the valve is relatively deep with the reticulate surface ornamentation showing up distinctly. The marginal area is broad and crossed by very few, distinct, simple and straight radial pore canals. The line of concrescence departs slightly from the inner margin around the anterior and posterior ends. Hinge structure of left valve agrees with typical *Eucytherura* hinge. Vertical hinge ears are slightly pronounced in the left valve.

Dimensions of Holotype No. 4006, a left valve, from Locality 7: length, 0.30 mm.; height, 0.16 mm. Paratype No. 4007, a left valve, from Locality 7: length, 0.30 mm.; height, 0.17 mm.

Remarks.—This very distinctive species has been based upon left valves only. It appeared characteristic enough, however, to justify description. It has only been found at Locality 7 (Naheola formation). This species is similar to *Eucytherura claibornensis*

Stephenson, *Eucytherura latebrosa* n. sp., and *Eucytherura stephensoni* n. sp. A discussion of the differences between these species is given later in this paper under the description of *Eucytherura stephensoni* n. sp.

EUCYTHERURA HIWANNEENSIS
Weingeist, n. sp.
Plate 73, figure 10

Carapace very small, relatively heavy. In lateral view sub-ovate. Dorsal margin straight, ventral margin slightly convex and obscured by outline of carapace. Anterior end broadly rounded forming a distinct angle with dorsal outline. Anterior margin appears to be thickened, showing several indentations, especially on the lower half. Posterior end compressed and projected into a point which lies in the upper one fourth of the valve. Upper and lower portions of the posterior end are almost straight and meet at an angle of approximately 120 degrees. Greatest height lies in the middle and greatest thickness close to the venter in front of the postero-ventral angle. A prominent eye spot sits just below the anterior cardinal angle. The surface is ornamented with indistinct angular pits which are separated from each other by a reticulate pattern of ridges which bear spiny projections. A backward deflected alar projection sits above the postero-ventral angle. A somewhat prominent spiny elevation lies in front of the posterior cardinal angle close to the dorsal outline. Normal pore canals appear to end in the pits of the reticulate surface. A faint, blade-like ridge extends from the antero-ventral angle along the venter as far back as the middle of the ventral outline. Viewed from the inside the valve is relatively deep. Marginal area is broad and crossed by a few, indistinct and simple radial pore canals. Inner margin runs parallel to the outer margin throughout its course. Line of concrescence could not be traced. Hinge of left valve shows structure typical of *Eucytherura* as described under the discussion of the genus. Hinge ears are not very pronounced.

Dimensions of Holotype No. 4008, a left valve, from Locality 15: length, 0.29 mm.; height, 0.17 mm.

Remarks.—This species is based upon a single left valve which appears sufficiently distinctive to justify description. *Eucytherura hiwanneensis* n. sp. is somewhat similar to *Eucytherura murdercreekensis* Howe and Law. It departs from it, however, in two main features. The end of *Eucytherura murdercreekensis* forms an angle of 90 or less degrees, while in *Eucytherura hiwanneensis* the point forms an angle of approximately 120 degrees. Also the new species is not devoid of ornamentation at its posterior end as is Howe and Law's species.

EUCYTHERURA IMPORCATA Weingeist, n. sp.
Plate 73, figure 13

Carapace very small, relatively heavy. In lateral view short and sub-polygonal. Dorsal margin straight, ventral outline convex and converging with the dorsum towards the posterior end. Ventral margin is obscured in side view by an inflated portion of the carapace. Anterior end somewhat obliquely rounded and forms a distinct angle with the dorsal margin. Anterior cardinal angle set back relatively to antero-ventral angle. Posterior end compressed and devoid of surface ornamentation. It is produced into a blunt point formed by a shorter almost straight upper portion and a longer slightly convex lower portion. A prominent glassy ocular spot is close to the anterior cardinal angle. Surface of carapace covered with a pattern of angular pits. These are separated from each other by a network of fine ridges. On clear specimens this reticulate pattern can be easily seen from the inside. One hole in each individual pit appears to indicate a normal pore canal. The valve is divided into two halves by a vertical depression which extends from the middle of the dorsal outline towards the venter without reaching it completely. A faint ridge runs along the ventrum from the antero-ventral angle as far as the middle. A prominent backwardly deflected alar protuberance lies just above the postero-ventral angle. Another less prominent double protuberance sits above and slightly anterior to the posterior cardinal angle. Greatest height of carapace in the anterior one fifth of the valve. Greatest thickness close to the ventral margin in the posterior half of the carapace. Viewed from the inside the valve is relatively deep. Marginal area is broad and distinct. It is widest and almost transparent around the

anterior and posterior ends where the line of concrescence appears to depart slightly from the inner margin. Radial pore canals, few in number, simple and straight. Muscle scar pattern not very distinct but recognizable as typical of *Eucytherura*. Hinge line also typical for the genus.

Dimensions of Cotype No. 4009, a right valve, from Locality 1: length, 0.25 mm.; height, 0.16 mm. Cotype No. 4010, a left valve, from Locality 1: length, 0.27 mm.; height, 0.17 mm.

Remarks.—This rather common species has been found only in the Lower Weno formation of Texas (Locality 1).

EUCYTHERURA LATEBROSA Weingeist, n. sp.
Plate 73, figures 14, 17

Carapace very small but relatively heavy. In side view subquadrate. Dorsal margin straight, obscured partially by the dorsal outline of the carapace. Ventral outline slightly convex hiding straight ventral margin completely in lateral view. Ventral margin converges somewhat with dorsum towards the posterior end. Anterior end broadly rounded forming distinct angle with dorsal outline. Lower half of anterior margin shows prominent indentations. Posterior end compressed and produced into a point which lies in the upper one third of the valve. Lower portion of posterior end straight, upper and shorter portion slightly concave. Greatest height at the middle of valve, greatest thickness close to postero-ventral angle. Prominent glassy eye spot just behind anterior cardinal angle. Surface of carapace ornamented with a somewhat indistinct reticulate pattern of subangular pits. One normal pore canal appears to end in each individual pit. A faint and short horizontal ridge extends backwards from the lower half of the anterior margin. A small fringe along the anterior end and the entire posterior end are devoid of surface ornamentation. A rather inconspicuously depressed area extends towards the venter along the middle of the carapace. A distinct backward deflected alar projection of ragged appearance lies above the postero-ventral angle. This projection is three-lobed vertically. The lowest lobe is the largest. Just ahead of it sits a spine-shaped projection making the ala appear double in a ventral view. There are two ridges running along the ventral outline. One extends from the antero-ventral angle backwards as far as the middle of the venter. The other one is slightly removed from the ventral margin and starts somewhat ahead of the end of the first ridge. It extends backwards to the postero-ventral angle. A rather distinct ragged sharp-edged swelling lies just ahead of the posterior cardinal angle. Viewed from the inside the valve is relatively deep. Marginal area broad and crossed by very few, indistinct and simple radial pore canals. Inner margin runs parallel to the outer margin throughout. The line of concrescence cannot be traced. Muscle scar pattern is typical for the genus. Hinge agrees with the one described for the genus. Vertical hinge ears are only slightly pronounced.

Dimensions of Holotype No. 4011, a right valve, from Locality 8: length, 0.32 mm.; height, 0.18 mm. Paratype No. 4012, a left valve, from Locality 8: length, 0.29 mm.; height, 0.16 mm.

Remarks.—This species is closely related to *Eucytherura claibornensis*, Stephenson, *Eucytherura decorata* n. sp. and *Eucytherura stephensoni* n. sp. and the differences are discussed in detail under the description of the last. *Eucytherura latebrosa* n. sp. is rather common in the Midway (Locality 8). One specimen was obtained from Locality 5, the type locality of the Naheola formation (Midway).

EUCYTHERURA MARIANNENSIS
Weingeist, n. sp.
Plate 73, figures 23, 24

Shell heavy, relatively large for this genus. Carapace in side view subquadrate in the male and subovate in the female. Dorsal margin straight, somewhat obscured by irregular dorsal outline of carapace. Ventral outline slightly convex in the male, more so in the female. It converges posteriorly with the dorsum. Anterior end truncated but broadly rounded and forming an angle with dorsal outline. Anterior margin indented. Posterior end produced into a rounded point which lies in the upper third of the valve. Greatest height of male valve in the anterior one fifth of carapace. Greatest height of female valve in the middle. Greatest thickness close to postero-ventral angle. No

prominent ocular spot is visible from the outside. It is probably obscured by the heavy surface ornamentation. Exterior surface of carapace covered by prominent and relatively large angular pits which are separated from each other by a network of fine ridges. Several normal pore canals end in each individual pit. A pronounced backwards deflected swelling lies just above the postero-ventral angle. A number of faint and indistinct ridges give the anterior end and the dorsum a ragged appearance. A short and rather indistinct ridge extends horizontally backwards for a short distance from the lower half of the anterior end. Another extends along the venter from the anterior angle to the middle of the ventral outline. Seen from the inside the valve is rather deep. Marginal area broad and crossed by very few, indistinct and simple radial pore canals. Line of concrescence is difficult to trace but appears to coincide with the inner margin throughout. Ocular depression very distinct viewed from the inside. Hinge structure typical. Vertical hinge ears only very slightly pronounced in the left valve. Sexual dimorphism appears to be very distinct in this species.

Dimensions of Cotype No. 4013, a female left valve, from Locality 16: length, 0.39 mm.; height, 0.25 mm. Cotype No. 4014, a male right valve, from Locality 16; length 0.39 mm.; height, 0.23 mm.

Remarks.—This species has been found only in the Marianna limestone (Locality 16) where it occurs rather commonly. It is interesting that both cotypes have a small piece of biotite incrusted at corresponding places.

EUCYTHERURA OCULATA Weingeist, n. sp.
Plate 73, figure 18

Carapace small, relatively heavy, subovate in side view. Dorsal margin straight, ventral outline slightly convex and converging posteriorly with the dorsal outline. Ventral margin straight and almost entirely obscured in lateral view by out-bulging ventral portion of carapace. Anterior end broadly rounded forming an angle slightly larger than 90 degrees with the dorsal outline. A narrow lip projects slightly over the anterior margin. Posterior end compressed and produced into a blunt point which lies in the upper half of the valve. Both portions of the posterior end are convex, the lower one is longer and more inclined. Greatest height in anterior one fifth of valve along a line from the anterior cardinal to the antero-ventral angle. Greatest thickness close to the venter in the posterior one third of the valve. Very prominent glassy ocular spot just behind the anterior cardinal angle. Surface covered by small angular pits. A normal pore canal ends in each individual pit. Surface marked by four distinct swellings. The most prominent one is formed by two blunt ridges, one horizontal, the other one vertical which meet just above the posterior ventral angle. Another prominent dome-shaped swelling lies ahead and below the center of the carapace. An elongated hump-shaped swelling lies close to the dorsal outline just ahead of the posterior cardinal angle. Anterior to this is a less prominent conical-shaped protuberance. A faint, indistinct ridge runs along the outline of the carapace from about the middle of the anterior margin to the postero-ventral angle. Viewed from the inside the valve is deep and flanked by a broad marginal area. This is crossed by very few, indistinct and simple radial pore canals. Line of concrescence cannot be traced distinctly but seems to coincide with the inner margin throughout. The inner margin runs parallel to the outer margin. Hinge of left valve typical for this genus. Vertical hinge ears are only very slightly pronounced.

Dimensions of Holotype No. 4015, a left valve, from Locality 4: length, 0.32 mm.; height, 0.18 mm.

Remarks.—This is a very distinctive species even though it is based on only one left valve from the Midway (Locality 4).

EUCYTHERURA STEPHENSONI
Weingeist, n. sp.
Plate 73, figures 3, 8

Carapace very small, relatively heavy. Subovate in lateral view. Dorsal outline slightly convex obscuring straight dorsal margin. Ventral outline convex hiding ventral margin in side view. There is a slight convergence posteriorly between the dorsal and ventral outlines. Anterior end evenly rounded with very faint indentations at its lower half. Posterior end compressed and

produced into a point which lies in the upper third of the valve. Both the upper and the lower portion of the posterior end have a concave reentrant. Greatest height slightly anterior to the middle of the carapace. Greatest thickness somewhat posterior to the middle of the venter. A distinct and prominent eye spot lies close to the anterior cardinal angle. Surface of carapace covered with angular pits separated from each other by a network of fine ridges. Pits are arranged in a diagonal manner. About twelve can be counted vertically along the greatest height of the valve. The flattened posterior end is devoid of ornamentation. A very faint ridge extends almost horizontally backwards from slightly below the middle of the anterior end. A more prominent ridge runs from the lower end of the anterior margin backwards along the venter as far as its center. There is a somewhat depressed area extending through the central portion of the carapace towards the ventral outline. The body of the carapace appears almost truncated close to the posterior end making the compressed end look like a beak in dorsal view. A ridge which gives a cliffed appearance to the valve lies anterior to the posterior cardinal angle. It is arched, upwardly convex and present on both valves. In dorsal view of the complete carapace these ridges almost converge at about the middle of the dorsum. From there they run parallel to each other as far as just anterior to the ocular spot where they descend and converge at the anterior end. The dorsal margin proper is obscured by these ridges and a raised portion of the carapace which extends from the middle of the dorsal outline backwards to the posterior cardinal angle.

Viewed from the inside the valve is relatively deep. The marginal area is moderately broad, slightly wider around the anterior and posterior ends. It is crossed by very few, indistinct and simple radial pore canals. The line of concrescence is difficult to trace but appears to coincide with the inner margin throughout. Normal pore canals are numerous and end in the angular pits of the surface. Hinge of right valve agrees with typical *Eucytherura* hinge line.

Dimensions of Holotype No. 4016, a complete carapace, from Locality 10: length, 0.34 mm.; height, 0.20 mm. Paratype No. 3352 (=Hypotype No. 3352 of *Eucytherura claibornensis* of Stephenson 1946), a right valve, from Locality 10: length, 0.35 mm.; height, 0.20 mm.

Remarks.—This species is based upon a complete carapace and a right valve distinctive enough to justify description. The right valve is Stephenson's (1946) Hypotype No. 3352 of *Eucytherura claibornensis* Stephenson 1944. Because it was found to differ from the holotype of *Eucytherura claibornensis* sufficiently to establish a new species, Stephenson's hypotype has been made a paratype of *Eucytherura stephensoni* n. sp. Specimens from Locality 6 are smaller but agree in all other shell characteristics with *Eucytherura stephensoni* and have been placed in this species.

Eucytherura claibornensis Stephenson, *Eucytherura decorata* n. sp., *Eucytherura latebrosa* n. sp. and *Eucytherura stephensoni* n. sp. are somewhat similar to each other. *Eucytherura stephensoni* differs from the other three species in lacking the prominent ragged alar ventral protuberance. *Eucytherura claibornensis* differs from *Eucytherura stephensoni* in having a coarser pitted ornamentation. The former species has not more than eight pits in a vertical row along its greatest height while the latter one has not less than twelve pits in that same direction. Only *Eucytherura claibornensis*, *Eucytherura stephensoni* and *Eucytherura latebrosa* have the short horizontal ridge which extends backwards from the lower half of the anterior margin. *Eucytherura decorata* and *Eucytherura latebrosa* have a distinct angle where anterior and dorsal outlines meet. The other two species are rounded at this same point. *Eucytherura decorata* differs from *Eucytherura latebrosa* in having a distinct blunt ridge along the dorsal outline which is absent in the latter species. Also, the former has a characteristically thickened anterior margin crossed by radial short ridges, not present in the latter species.

EUCYTHERURA STRUMOSA Weingeist, n. sp.
Plate 73, figures 12, 21

Carapace very small but relatively heavy. In side view elongate and subrectangular. Dorsal and ventral margins straight, converging slightly towards the posterior end.

In lateral view the ventral margin is largely obscured by a swollen portion of the carapace. Anterior end almost squarely truncated but somewhat rounded. It forms a very distinct angle with the dorsal outline. Posterior end compressed and slightly pointed. Prominent ocular spot close to the anterior cardinal angle.

Surface ornamented with an irregularly complex series of tubercle-shaped swellings. A tubercle lies vertically below the eye spot at about half the height of the valve. A very pronounced vertically elongated swollen area lies just anterior to the center of the carapace. It extends from close above the ventral outline to near the dorsal outline without reaching it. Another prominent area of swellings lies in the posterior half of the valve. This extends from above the center of the ventral outline towards the posterior cardinal angle. It has three distinct tubercle-shaped projections. The largest one lies in the middle of the swollen area and forms a backwardly deflected and elongated tubercle. The other two are less prominent. The one closest to the ventral margin is oval. The one close to the posterior cardinal angle is button-shaped. The surface of the carapace is also covered by a number of small node-like projections which form the exterior ends of normal pore canals. Greatest height lies in the anterior one sixth of valve. Greatest thickness in the posterior half, close to the ventrum.

Viewed from the inside the valve is relatively deep. The marginal area is broad, widest and translucent around the anterior and posterior ends. It is crossed by very few, straight and simple radial pore canals. Line of concrescence can be traced only along the posterior end where it lies somewhat closer to the outer than to the inner margin. It is slightly indented there at the radial pore canals. Hinge of right valve is typical for *Eucytherura* as described under the discussion of the genus.

Dimensions of Holotype No. 4017, a right valve, from Locality 1: length, 0.33 mm.; height, 0.17 mm.

Remarks.—This very conspicuous species has been described upon the basis of two right valves only. It has been found only in the Comanchean (Localities 1 and 3).

EUCYTHERURA TRICORNIS Weingeist, n. sp.
Plate 73, figure 20

Carapace very small, relatively heavy. In lateral view subpolygonal. Dorsal margin straight, ventral margin slightly convex and somewhat converging with dorsal margin posteriorly. Anterior end obliquely truncated but rounded in a wide arch. Faint tooth-like projections, about four in number, sit on the lower half of the anterior margin. Posterior end compressed and produced into a point which lies in the upper one third of the valve. Greatest height in a line which passes through the anterior cardinal angle. Greatest thickness close to the ventrum slightly behind the middle of the valve. Pronounced ocular spot just behind anterior cardinal angle. Surface of the carapace covered by small angular pits which can be seen from the inside. One normal pore canal ends in each individual pit. The surface is also ornamented with three prominent tubercle-shaped swellings. The largest is deflected backwards and lies slightly anterior and above the postero-ventral angle. The next largest one is spherical and is just ahead of and below the center of the valve. The third swelling lies above the dorsal margin a short distance ahead of the posterior cardinal angle.

Viewed from the inside the valve is relatively deep. The marginal area is rather broad and widest around the anterior and posterior ends. The line of concrescence cannot be traced distinctly but appears to coincide with the inner margin. Radial pore canals few in number, very indistinct and simple. Hinge structure of left valve typical of *Eucytherura*. Vertical hinge ears are only very slightly pronounced.

Dimensions of Holotype No. 4018, a left valve, from Locality 14: length, 0.28 mm.; height, 0.16 mm.

Remarks.—This species has been based upon a single left valve. Another broken specimen has been found at Locality 13. This species is only known from the Jackson (Eocene).

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ALLEGHENY CONODONTS FROM EASTERN OHIO

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ABSTRACT—Late Paleozoic conodonts have been given relatively little study, and no descriptions of them from the Pennsylvanian of Ohio, or any other part of eastern United States have been previously published. In this paper there are described and illustrated representative specimens from two assemblages which were secured from the Hamden limestone and the Washingtonville shale of the Allegheny formation. Conodonts referable to the genera *Cavusgnathus*, *Gnathodus*, *Hibbardella*, *Hindeodella*, *Ligonodina*, *Idiognathodus*, *Ozarkodina*, *Prioniodus*, *Spathognathodus*, and *Streptognathodus* are present. Two new species are described. The assemblages from these two members of the Allegheny formation are very much alike and differ only in detail.

INTRODUCTION

ONLY a relatively few reports on late Paleozoic conodonts have been published to date. Although several unpublished studies exist, and an occasional note has appeared in this Journal and elsewhere regarding the presence of conodonts (*e.g.*, Payne, 1937, p. 279 Dubois, 1943), no specimens from the Pennsylvanian have thus far been systematically described from eastern United States. Recently we secured two conodont assemblages from a number of localities in the Hamden limestone and the Washingtonville shale of the Allegheny formation in eastern Ohio. These conodonts are the basis for the present report.

STRATIGRAPHIC CONSIDERATIONS

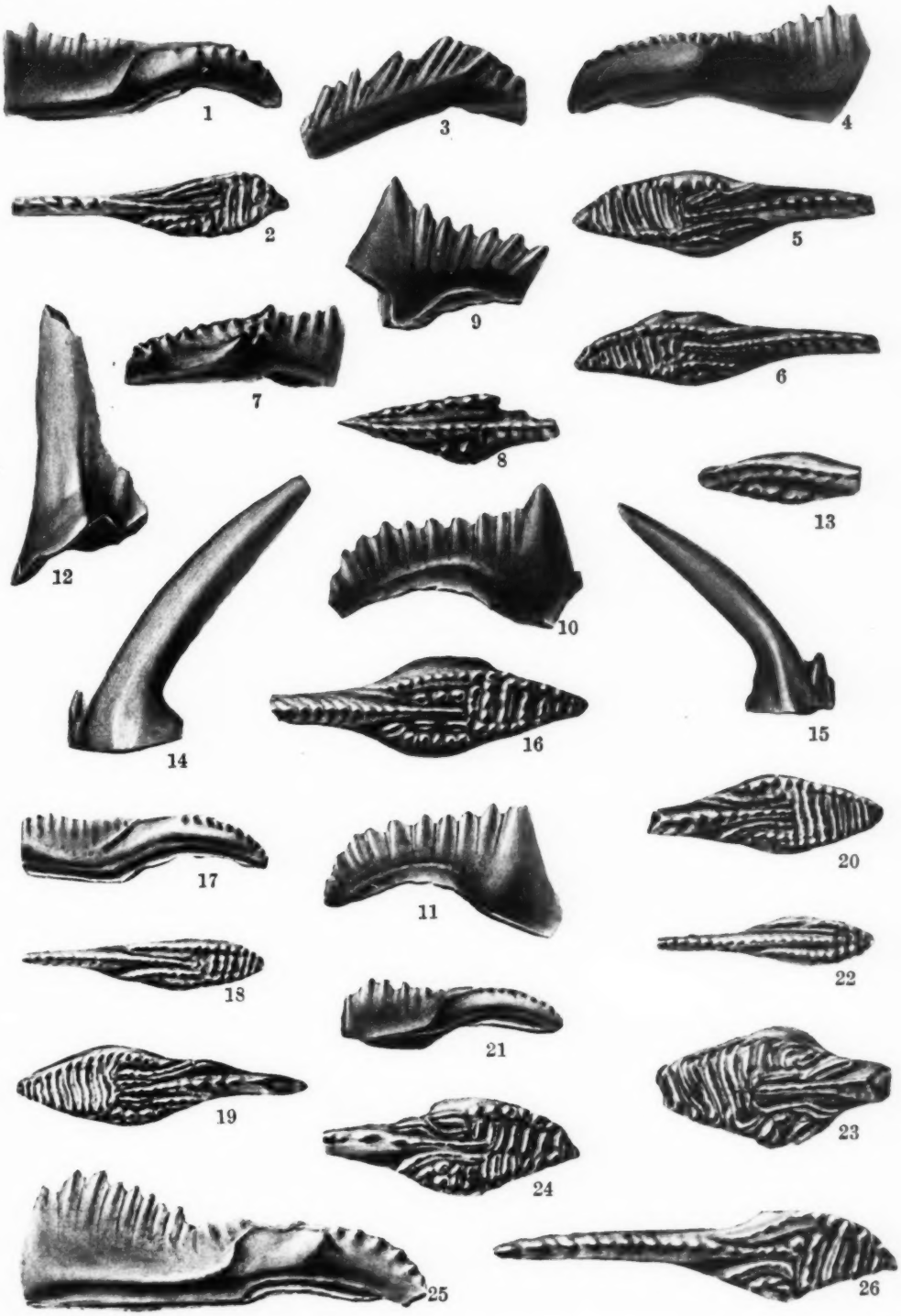
The Hamden limestone and Washingtonville shale members lie near the middle of the Allegheny formation of eastern Ohio. The relative positions of these two members together with their stratigraphic associations were presented in composite form by Stout (1939, stratigraphic chart) and we are presenting the data in slightly modified form:

Shale and sandstone	10′	
Shale, marine; *Washingtonville*	4′	
Coal, persistent; *Middle Kittanning*, No. 6	4′	
Clay, siliceous	3′	6″
Limestone, impure, local, fresh-water; *Salem*	0′	6″
Shales, siliceous, with *Red Kidney* ore	10′	
Coal, local; *Strasburg*	0′	6″
Clay, flint and plastic; *Oak Hill*	4′	
Shales, siliceous	3′	
Limestone, shaly, marine; *Hamden*	4′	
Coal; *Lower Kittanning*, No. 5	2′	4″
Total average thickness of composite section	45′	10″

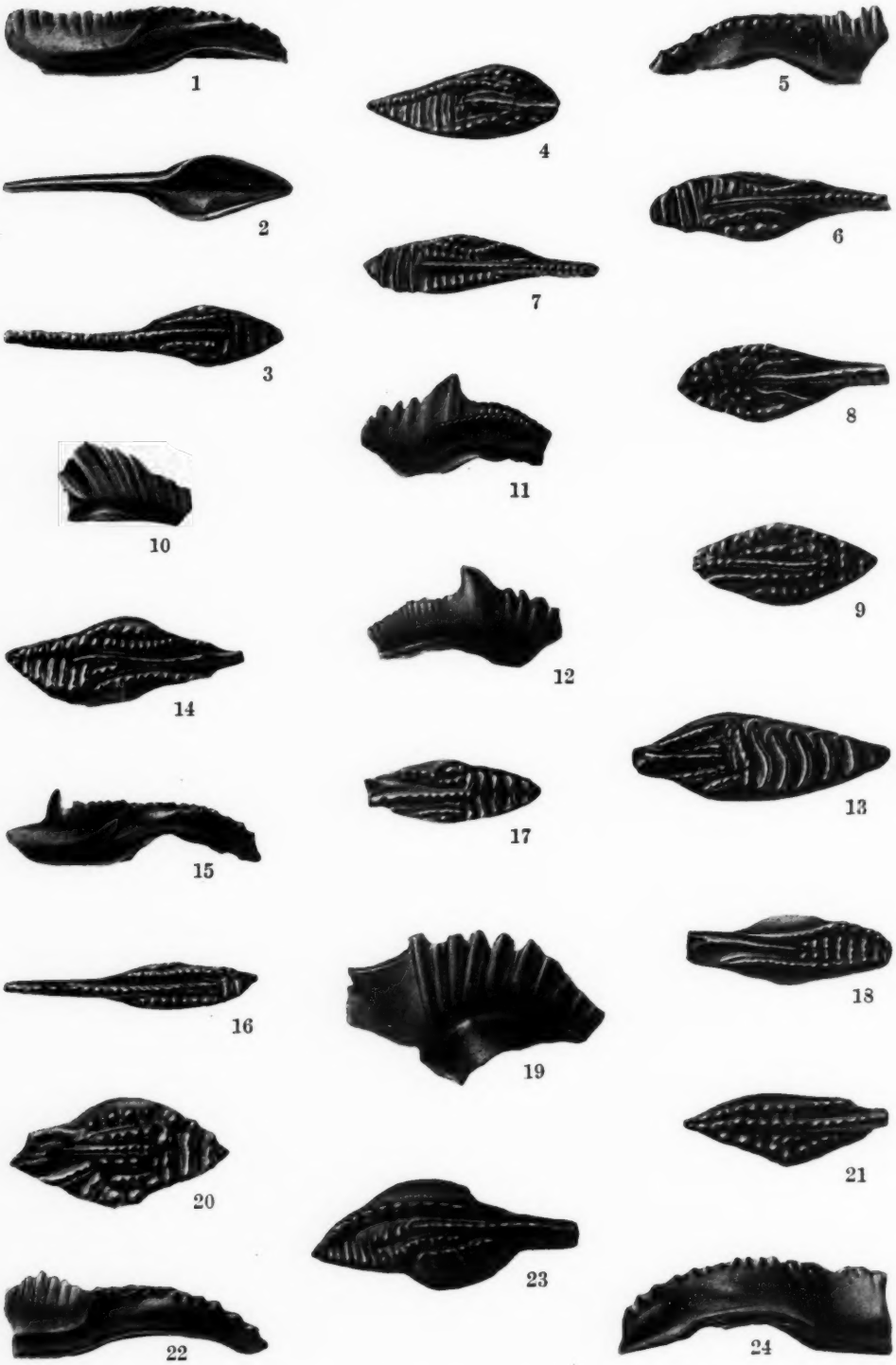
EXPLANATION OF PLATE 74

All specimens are from the Hamden limestone of the Allegheny formation in eastern Ohio. The figures are ×40.

FIGS. *1, 2*—*Idiognathodus ohioensis* Sturgeon and Youngquist, n. sp. Two views of a paratype. (See also figs. *25, 26*.) (p. 383)
3—*Ozarkodina* sp. (p. 385)
4–6—*Idiognathodus* spp. Figures *4, 5* represent one specimen. (p. 384)
7, 8—*Gnathodus* sp. Lateral and oral views of a single specimen. (p. 383)
9–11—*Spathognathodus minutus* (Ellison). Outer lateral views of three specimens from three localities. (See also pl. 75, fig. 19.) (p. 385)
12—*Prioniodus* aff. *P. cacti* Gunnell. Inner view of a specimen from Mahoning Co., Ohio. (p. 385)
13—*Cavusgnathus* sp. (p. 383)
14, 15—*Ligonodina* aff. *L. lexingtonensis* (Gunnell). Outer lateral views of two specimens. (p. 384)
16–24—*Idiognathodus* spp. Figures *17, 18* represent one specimen, as do also figures *21, 22*. (p. 384)
25, 26—*Idiognathodus ohioensis* Sturgeon and Youngquist, n. sp. Inner lateral, and oral views of the holotype. (See also figs. *1, 2*.) (p. 383)



Sturgeon and Youngquist, Allegheny Conodonts from Eastern Ohio



Sturgeon and Youngquist, Allegheny Conodonts from Eastern Ohio

The Hamden member is a rather thin marine shale and limestone which overlies the Lower Kittanning coal. The lithology of the Hamden is variable and at different localities may occur as a black carbonaceous shale, a gray calcareous and pyritiferous shale containing nodular limestone, or a gray argillaceous shale with a few scattered siderite concretions. Invertebrate fossils are usually abundant and are particularly common in the gray calcareous and pyritiferous shale which has yielded the conodonts for this study. Conodonts, however, are not abundant, and in addition finely crystalline secondary pyrite growths together with the general resistance of the shale to the various means of disintegration combine to cause the conodonts to become broken, particularly during the separation processes. Of the more than 400 conodonts available from the Hamden, almost all are fragmentary.

The Washingtonville shale lies on or close above the Middle Kittanning coal. In its type area this member is a thin, black, carbonaceous shale which contains a marine fauna and was so originally described (Stout and Lamborn, 1924, pp. 175–181). At certain localities in Ohio, other than the type area, however, the Washingtonville is a gray, argillaceous, and a very fossiliferous shale. Our collections of Washingtonville conodonts are from the dark gray rather than the black carbonaceous shale facies. Like the specimens from the Hamden, the Washingtonville conodonts are neither abundant nor well preserved. Of the approximately 300 individuals obtained, only one or two are entire or nearly so.

THE CONODONTS AND ASSOCIATED CEPHALOPODS

The direct association of Pennsylvanian conodonts with macrofossils of stratigraphic value has so far not generally been noted. This is undoubtedly due in part to the fact that conodonts commonly occur where other fossils are lacking. However, cephalopods in considerable abundance have been found in both the Hamden limestone and the Washingtonville shale and have been described by Sturgeon (1946), Miller and Sturgeon (1946), and Sturgeon and Miller (1948). In the following paragraphs we have tabulated the cephalopod faunas of each of these members together with the conodonts which are now known to be associated with them.

The Hamden limestone has yielded the following cephalopods:

Pseudorthoceras knoxense
Mooreoceras normale
Brachycycloceras ohioense
Poterioceras curtum
Ephippioceras ferratum
Liroceras liratum
Temnocheilus medioventralis
Temnocheilus sp.
Metacoceras perelegans
M. lambi
M. spp.
Domatoceras obsoletum
D. shepherdi
Solenochilus greenensis
Gonioglyphioceras sp.
Eoasianites cf. *E. globulosus*
Wellerites sp.

The conodonts now known from the Hamden limestone are:

Cavusgnathus sp.
Gnathodus sp.
Idiognathodus ohioensis, n. sp.
I. spp.
Ligonodina aff. *L. lexingtonensis* (Gunnell)
Ozarkodina sp.
Prioniodus aff. *P. cacti* Gunnell
Spathognathodus minutus (Ellison)

Hindeodella and *Streptognathodus* are also represented by a very few fragmentary and unfigured specimens.

EXPLANATION OF PLATE 75

All specimens are from the Washingtonville shale of the Allegheny formation in eastern Ohio. The figures are ×40.

FIGS. *1–9*—*Idiognathodus* spp. Figures *1–3* represent outer lateral, aboral and oral views of a fairly complete individual; figures *4*, *7–9* show oral views of 4 specimens; figures *5*, *6* illustrate one individual by inner lateral, and oral views. (p. 384)
10—*Ozarkodina* sp. (p. 385)
11, *12*—*Cavusgnathus arca* Sturgeon and Youngquist, n. sp. Inner and outer lateral views of the holotype. (p. 383)
13–18—*Idiognathodus* spp. Figures *15*, *16* represent one individual. (p. 384)
19—*Spathognathodus minutus* (Ellison) Outer lateral view. (See also pl. 74, figs. *9–11*.) (p. 385)
20–24—*Idiognathodus* spp. Figures *23*, *24* illustrate one individual. (p. 384)

The Washingtonville shale has yielded the following cephalopods:

Pseudorthoceras knoxense
Domatoceras shepherdi
Imitoceras ? spp.

Mooreoceras tuba, *Temnocheilus* sp., and *Metacoceras perelegans* have not been described as yet from the Washingtonville but were collected recently from that member by the senior author of this report.

The conodonts now known from the Washingtonville shale are:

Cavusgnathus arca, n. sp.
Idiognathodus spp.
Ozarkodina sp.
Spathognathodus minutus (Ellison)

Fragmentary specimens from the Washingtonville which can be generically identified with certainty but which are not illustrated in our report are referable to *Hibbardella*, *Hindeodella* and *Streptognathodus*.

GENERAL COMPOSITION AND SIGNIFICANCE OF ASSEMBLAGES

These two conodont assemblages secured from the Hamden limestone and Washingtonville shale, respectively, differ only in detail, and further collecting might well eliminate even these differences.

The aspect of both faunas is in harmony with the generally accepted middle Pennsylvania age of the Allegheny formation. Representatives of *Idiognathodus* dominate our collections; *Streptognathodus* is comparatively rare. *Cavusgnathus*, *Gnathodus*, *Hibbardella*, *Hindeodella*, *Ligonodina*, *Ozarkodina*, *Prioniodus* and *Spathognathodus* are also present but make up a minor element in the total assemblage. The Allegheny is approximately equivalent to the Des Moines beds of the Upper Mississippi River valley and the conodonts from the Hamden limestone and Washingtonville shale members of the Allegheny seem to be perhaps closest to the few specimens which have been described from the Lexington coal in Missouri. Because of a slightly different facies resulting perhaps from the distance to other described conodont faunas, and because of the relatively few conodonts so far reported on from the late Paleozoic, some of our specimens appear to represent new species, but most of them are too fragmentary to serve satisfactorily as holotypes.

COLLECTING LOCALITIES

The following localities, all in Ohio, yielded the conodonts described and illustrated in this report:

Hamden limestone:
1. Delmore Mine, SW ¼ sec. 14, Salem Tp., Columbiana Co.
2. F. K. Fryfogle Mine, W-center sec. 12, Knox Tp., Columbiana Co.
3. F. L. Reed Mine, NW ¼ sec. 21, Green Tp., Mahoning Co.
4. J. Pascola Mine, SW ¼ sec. 33, Green Tp., Mahoning Co.
5. Bunker Hill Mine, SW ¼ NW ¼ sec. 16, Goshen Tp., Mahoning Co.
6. H. L. Daugherty Mine, NE-corner sec. 19, Green Tp., Mahoning Co.
7. McDaniel Mine, SE¼ sec. 36, Smith Tp., Mahoning Co.

Washingtonville shale:
1. Davis Mine, SE ¼ sec. 9, Virginia Tp., Coshocton Co.
2. SW ¼ sec. 26, Perry Tp., Columbiana Co.
3. W-center sec. 9, Center Tp., Columbiana Co.

For the sake of completeness it should be added that a few specimens (not figured) which are essentially duplicates of the forms we are illustrating were obtained from the Hamden member of the Allegheny formation at the Allison Mine in the N-center of sec. 29, and at the Brookwood Mine in the W-center of sec. 29, both in Perry Tp., Columbiana Co.; also from the same member at the J. Shephard Mine in the SW ¼ NW ¼ sec. 20, Green Tp., Mahoning Co., Ohio.

ACKNOWLEDGMENTS

A grant from the Ohio University Fund, Inc., made the preparation of this report financially possible, and we express our appreciation for this aid. Mr. William O. Smith and Mr. Phillip G. Cook assisted in washing samples and picking the specimens. Dr. Harold Wanless and Mr. Robert O. Fay have given us suggestions in regard to certain unpublished studies of Pennsylvanian conodonts. The illustrations which accompany this report are photographs prepared with the generous help of Mr. R. H. Downs, and were retouched by Mr. Howard Webster of Iowa City. All type and figured specimens are in the Geological Museum of the Department of Geology at

The Ohio State University, Columbus, Ohio.

SYSTEMATIC PALEONTOLOGY

CAVUSGNATHUS ARCA Sturgeon and Youngquist, n. sp.
Plate 75, figures 11, 12

The holotype is fairly small, narrow, and gently bowed with the convex side outward. The outer margin of the parapet is produced anteriorly into a blade which is deflected inward near its anterior end, and consists of about five subequally-sized denticles all anterior of the cusp. In width, the cusp is equal to about three denticles and it is high and inclined posteriorly. The oral surfaces, particularly the margins, of both the inner and outer parapets are minutely rugose transversely. The most distinctive feature of this species, aside from its rather small size and minute rugosity, is its profile in lateral view. That is, both the oral and aboral margins are strongly curved, the specimen being arched orad. In other representatives of *Cavusgnathus*, such as *C. giganta* and *C. lauta* both of Gunnell, from the Pennsylvanian and Lower Permian, and in *C. cristata* Branson and Mehl, from the Mississippian Caney shale of Oklahoma, the aboral margin is nearly straight, and the profile of the oral margin is but slightly convex. The holotype of our species is somewhat incomplete both anteriorly and posteriorly but it appears that these missing portions when present would further accentuate the arched nature of this form.

Occurrence.—Washingtonville shale, Coshocton Co., Ohio (loc. 1).

Holotype.—Ohio State Univ., 19620.

CAVUSGNATHUS sp.
Plate 74, figure 13

Only a single specimen in our collections from the Hamden limestone appears to be referable to *Cavusgnathus*, and it is fragmentary. It cannot be effectively delimited specifically but is probably distinct from our *C. arca*, n. sp., for it has a fairly straight aboral margin and the rugosity of the parapet is much coarser than in *C. arca*.

Occurrence.—Hamden limestone, Mahoning Co., Ohio (loc. 4).

Figured Specimen.—Ohio State Univ., 19621.

GNATHODUS sp.
Plate 74, figures 7, 8

Among the several hundred specimens in our collections, the genus *Gnathodus* is represented by only a single individual and it is fragmentary. However, the platform is preserved entire together with a small portion of the blade. Of the described species of *Gnathodus*, our specimen is perhaps closest to the particular one figured by Ellison (1941, pl. 23, fig. 25—plate legend misprinted as "24, 26–28"; should read "23, 25–28") and referred to *G. roundyi* Gunnell. It is also close to the holotype of that species (Gunnell, 1931, pl. 29, figs. 19, 20) which came from the Fort Scott limestone of Missouri. In regard to the distribution of this species Ellison (1941, p. 138) states that it is found in "all of the conodont-bearing zones of the Des Moines series in Missouri and Kansas" and adds that it occurs also in the Mineral Wells formation of Texas.

Occurrence.—Hamden limestone, Columbiana Co., Ohio (loc. 1).

Figured Specimen.—Ohio State Univ., 19622.

IDIOGNATHODUS OHIOENSIS, Sturgeon and Youngquist, n. sp.
Plate 74, figures 1, 2, 25, 26

The holotype of this species (figs. 25, 26) appears to be complete in essentially every detail. The aboral margin of the blade is straight; the platform is moderately arched and is about four-tenths as long as the blade. The posterior half of the oral surface of the platform is marked by four or five large transverse rugae; the outer margin of the posterior half of the platform is bordered by a small ridge, whereas the opposite margin bears two or three small nodes. Entire specimen gently bowed. In oral outline the platform is strongly rounded on its outer side, is expanded laterally along its anterior inner margin but becomes slightly concave in outline along the posterior portion of the inner margin. The blade is composed of about ten denticles which reach their maximum height in the anterior penultimate and antepenultimate ones. Aborally, the platform is broadly excavated forming the large escutcheon characteristic of *Idiognathodus* (as well as other of the Polygnathidae in the late Paleozoic).

Occurrence.—Hamden limestone: figures 1, 2, Mahoning Co., Ohio (loc. 3); figures 25, 26, Columbiana Co., Ohio (loc. 1). Probably also occurs in the Washingtonville shale but specimens are too fragmentary to permit positive identification.

Types.—Ohio State Univ., 19623 (holotype, figs. 25, 26) and 19624 (paratype, figs. 1, 2).

IDIOGNATHODUS spp.
Plate 74, figures 4–6, 16–24; plate 75, figures 1–9, 13–18, 20–24

As Ellison (1941, p. 108) has pointed out, conodont faunas of Des Moines age (approximately Allegheny equivalent) are dominated by "the presence of great quantities of idiognathodids." Higher in the geologic column, that is, in the Missouri and Virgil portions of the Pennsylvanian, these idiognathodids with broad platforms which are gently rounded orally, flat, or only slightly grooved, and have transverse ornamentation, give way to the streptognathids which commonly have a somewhat narrower platform that is concave on its oral surface, being grooved longitudinally. Ellison (1941, pp. 110–111) adds that in his experience with Virgil faunas "streptognathodids consistently make up over 85 per cent of the species in each sample . . . ." These observations are indeed consistent with the conodonts which we have from the Allegheny formation. That is, *Streptognathodus* is represented by only a very few specimens which are too fragmentary to merit illustration. In contrast, *Idiognathodus* is abundantly represented and, though many of the specimens are poorly preserved, sufficient of them retain their features so that the general nature of the assemblage can be ascertained from our illustrations. We have selected a number of different forms of *Idiognathodus* from both the Hamden limestone and Washingtonville shale. It seems clear that many new species are represented (*e.g.*, pl. 74, fig. 16; pl. 75, figs. 13, 18, 24, 25) but most of them lack all or a good part of the blade and we are reluctant to propose specific names for these individuals.

Certain of our specimens can be compared to advantage with previously described forms. Figure 7 on our plate 75 appears close to *Idiognathodus simplex* Gunnell (1933, pl. 32, fig. 19) from the Cherryvale shale of Missouri. Occurring slightly higher stratigraphically (lower Missouri) than our form, *I. simplex* has a tendency toward the streptognathodid form and it has a very slight groove on the oral surface of the platform which Ellison (1941, pp. 131–132) regarded as sufficiently important to refer it to *Streptognathodus* and put it in synonymy with *S. cancellosus*, adding, however, that "this species is a transition from more typical streptognathodids to typical idiognathodids." Our figure 18 on plate 74 is reminiscent of *Idiognathodus confragus* Gunnell (1933, pl. 31, fig. 43). Figure 20 on our plate 75 is of the same general form as *Idiognathodus* sp. of Youngquist and Heezen (1948, pl. 118, fig. 14). If *Streptognathodus* is represented by any of the figured specimens it is probably that shown by figures 21, 22, on plate 74 in which, however, the groove on the oral surface of the platform does not persist across the posterior portion of the platform.

Occurrence.—Hamden limestone: pl. 74, figures 4, 5, 16, 21, 22, Columbiana Co., Ohio (loc. 1); pl. 74, figures 6, 17, 18, 24, Mahoning Co., Ohio (loc. 5); pl. 74, figure 19, Mahoning Co., Ohio (loc. 7); pl. 74, figures 20, 23, Columbiana Co., Ohio (loc. 2). Washingtonville shale: pl. 75, figures 1–4, 7, 9, 15, 16, 22, Coshocton Co., Ohio (loc. 1); pl. 75, figures 5, 6, 20, 21, 23, 24, Columbiana Co., Ohio (loc. 3); pl. 75, figures 8, 13, 14, 17, 18, Columbiana Co., Ohio (loc. 2).

Figured Specimens.—Ohio State Univ., 19625 (pl. 74, figs. 4, 5), 19626 (pl. 74, fig. 6), 19627 (pl. 74, fig. 16), 19628 (pl. 74, figs. 17, 18), 19629 (pl. 74, fig. 19), 19630 (pl. 74, fig. 20), 19631 (pl. 74, figs. 21, 22), 19632 (pl. 74, fig. 23), 19633 (pl. 74, fig. 24), 19634 (pl. 75, figs. 1–3), 19635 (pl. 75, fig. 4), 19636 (pl. 75, figs. 5, 6), 19637 (pl. 75, fig. 7), 19638 (pl. 75, fig. 8), 19639 (pl. 75, fig. 9), 19640 (pl. 75, fig. 13), 19641 (pl. 75, fig. 14), 19642 (pl. 75, figs. 15, 16), 19643 (pl. 75, fig. 17), 19644 (pl. 75, fig. 18), 19645 (pl. 75, fig. 20), 19646 (pl. 75, fig. 21), 19647 (pl. 75, fig. 22), 19648 (pl. 75, figs. 23, 24).

LIGONODINA aff. L. LEXINGTONENSIS (Gunnell)
Plate 74, figures 14, 15

The cusp is long, rather stout, rounded on

its outer surface but flattened on the inner side, and recurved with maximum curvature near the base. The anterior and posterior edges of the cusp are sharp. In the cusps of both of the figured specimens there is an axis of inverted-V-shaped, light-colored, cone-like structures which are presumed to be light-reflecting growth surfaces. Denticles are preserved on one side of the cusp and there is an indication that a denticulate bar was originally present on the other side of the cusp of our specimens. As Ellison (1941, p. 115) has indicated, the presence of denticles on both sides of the cusp would probably place these individuals in *Ligonodina* rather than in *Prioniodus*—a genus occasionally used earlier for this general form in the Pennsylvanian.

Occurrence.—Hamden limestone: figure 14, Mahoning Co., Ohio (loc. 3); figure 15, Mahoning Co., Ohio (loc. 4).

Figured Specimens.—Ohio State Univ., 19649 (fig. 14), and 19650 (fig. 15).

OZARKODINA sp.
Plate 74, figure 3; plate 75, figure 10

Ozarkodina is but sparsely represented in the collections available from both the Hamden and Washingtonville members of the Allegheny. The specimen illustrated by figure 3 on plate 74 may be closely related to *O. delicatula*—at present a rather broadly interpreted species. The form illustrated on plate 75 may likewise belong in that species but only enough of the specimen is preserved to indicate its generic affinities.

Occurrence.—Hamden limestone: pl. 74, figure 3, Mahoning Co., Ohio (loc. 6). Washingtonville shale: pl. 75, figure 10, Columbiana Co., Ohio (loc. 2).

Figured Specimens.—Ohio State Univ., 19651 (pl. 74, fig. 3), and 19652 (pl. 75, fig. 10).

PRIONIODUS aff. P. CACTI Gunnell
Plate 74, figure 12

Though fragmentary, this specimen clearly belongs to a group of prioniodids which are of a generalized type and consequently have a long stratigraphic range. The cusp is large, flattened on its outer side, somewhat more rounded on its inner (figured) surface, sharpened anteriorly and posteriorly and rather straight. The anticusp is short and extends slightly toward the anterior. Near the base, on its inner side, the cusp flares laterally to encompass the large escutcheon. The denticles are compressed laterally and are fused with one another and with the cusp.

Occurrence.—Hamden limestone: Mahoning Co., Ohio (loc. 6).

Figured Specimen.—Ohio State Univ., 19653.

SPATHOGNATHODUS MINUTUS (Ellison)
Plate 74, figures 9–11; plate 75, figure 19

Spathodus minutus ELLISON, 1941, Jour. Paleontology, vol. 15, pp. 108, 109, 110, 111, 120, pl. 20, figs. 50–52; BRANSON, 1944, Missouri Univ. Studies, vol. 19, no. 3, p. 327.

Spathognathodus minutis ELLISON and GRAVES, 1941, Missouri Univ. Sch. Mines and Metall. Bull., tech. ser., vol. 14, no. 3, p. 3.

Spathognathodus minutus ELLISON and GRAVES, 1941, Missouri Univ. Sch. Mines and Metall. Bull., tech. ser., vol. 14, no. 3, pp. 3, 4, pl. 2, figs. 1, 3, 5; YOUNGQUIST and DOWNS, 1949, Jour. Paleontology, vol. 23, pp. 169, 170, pl. 30, fig. 4.

Representatives of this species are characterized by having the anterior edge forming an angle of about 45 degrees with the aboral margin, about 12 laterally compressed denticles composing the blade posterior to the cusp, and 3 short denticles anterior to the cusp. All of our figured specimens are incomplete posteriorly but two of them (pl. 74, figs. 10, 11) retain sufficient of this portion of the individual to preserve at least one denticle and the original presence of two more is strongly inferred. The preserved portions of the other figured specimens indicate that they too are almost certainly referable to *S. minutus*. Figure 19 on plate 75 is closely similar to that illustrated by Ellison in 1941 (pl. 20, fig. 52).

Occurrence.—Hamden limestone: pl. 74, figure 9, Columbiana Co., Ohio (loc. 1); pl. 74, figure 10, Mahoning Co., Ohio (loc. 6); pl. 74, figure 11, Mahoning Co., Ohio (loc. 5); Washingtonville shale: pl. 75, figure 19, Columbiana Co., Ohio (loc. 3). Reported from Iowa, Missouri, Texas and probably Kansas, in beds ranging in age from early Pennsylvanian to early Permian.

Figured Specimens.—Ohio State Univ., 19654 (pl. 74, fig. 9), 19655 (pl. 74, fig. 10), 19656 (pl. 74, fig. 11), 19657 (pl. 75, fig. 19).

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A GIANT SCAPHOPOD FROM THE PENNSYLVANIAN OF TEXAS

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ABSTRACT—A very large scaphopod from the Middle Pennsylvanian Millsap Lake formation (Strawn group) of north-central Texas is illustrated and described. It is referable to *Dentalium* (*Antalis*) *raymondi* (Young), previously known only from fragments from the Pennsylvanian of New Mexico and possibly Colorado.

LOCALLY, scaphopods, like other mollusks, are not rare in Late Paleozoic marine strata. However, they have received comparatively little attention for the great majority of them are small and none too well preserved, and they seem to be of no particular stratigraphic significance. Accordingly, the discovery of an exceptionally large and probably almost complete individual in the Middle Pennsylvanian Millsap Lake formation (Strawn group) of north-central Texas seems to merit special consideration.

This specimen was found in October, 1945, by S. G. Tuell, while on a collecting trip with R. J. Stark, and was kindly loaned to me for study by its discoverer. It appears to be considerably larger than any modern representative of the class. That is, the largest form[1] mentioned by Pilsbry and Sharp (1897–1898, pp. 65, 80) in their well known monograph of scaphopods is stated to attain a length of only 133 mm. and a corresponding maximum diameter of only 15 mm., measurements which are only something like half those of the specimen under consideration. Henderson (1920, pp. 59–62) indicates that there are no very large forms living in the "east American" area today—the largest specimen he describes is 108 mm. long and attains a maximum diameter of 14 mm.; another is 110 mm. long, but its greatest diameter is only 11 mm. Also, Twenhofel and Shrock (1935, p. 362) note that the shells of these animals "rarely attain a length of 15 cm. (6 in.)." However, *Dentalium* (*Plagioglypta*) *ingens* de Koninck of the Viséan of Belgium was believed by its author (de Koninck, 1883, p. 217) to have attained a length of some 20 and possibly even 30 cm. and a diameter of 25 mm.; and fragments of *D.* (*Antalis*) *ornatum* de Koninck of the same general horizon and locality suggest a length of at least 20 cm. and a maximum diameter of 22 mm.

Insofar as I have been able to ascertain, the literature contains few records of specimens of comparable size from Pennsylvanian or Upper Carboniferous strata. However, Girty (1903, p. 452) has briefly described from one locality in the Hermosa formation of the San Juan region, southwestern Colorado, some "rather plentiful fragments of . . . a *Denta'ium* of an unusually large size. The largest fragment is 85 mm. long and not less than 20 mm. in diameter. As the shell substance is in places at least 8 mm. thick, the complete diameter of this portion of the shell was probably 25 or 30 mm. . . . In the Cisco division of the Carboniferous, near Graham, Young County, Tex., an equally large *Dentalium*, of a possibly undescribed species, is found. A single incomplete specimen of this form measures 200 mm. in length, and other shorter pieces of larger size indicate that it must have attained a length of 300 mm. or more. The diameter of these large fragments is upward of 30 mm. and the shell is 4 or 5 mm. thick." Also, Young (1942, pp. 120–121, pl. 20, figs. 3–6, 8, 12) has recorded the occurrence of several fragments "of unusually large scaphopods" in the Magdalena group of north-central New Mexico (near Talpa and in Taos Canyon). His "largest fragment measures 2.9 cm. in diameter, at the large end, which is not complete, and 12.5 cm. in length. It is estimated, from the

[1] *Dentalium* (*Fissidentalium*) *vernedei* Hanley of the coasts of Japan and China.

rate of taper of the conch and from the examination of smaller fragments, that the total length of a conch having an anterior apertural diameter of about 3.0 cm. would be about 35.0 cm., by far the largest scaphopod ever described." Young's specimens, for which he coined both a generic and a specific name, *Prodentalium raymondi*, seem to be conspecific with the one under consideration, which attains about the same maximum "diameter" but is much more nearly complete.

It was shown by Waagen (1880, p. 181) that most probably "full-grown" representatives of *D.* (*Plagioglypta*) *herculeum* de Koninck from the Upper Permian of the Salt Range in northwestern India were 222 mm. long and had an oral aperture 20 mm. in diameter. Enderle (1900, p. 51, pl. 4, figs. 1a–1e) referred to this same species a specimen from the Permian of northwestern Turkey that is about 246 mm. long and has a maximum width of approximately 30 mm. Hayasaka (1925, p. 26, pl. 1, fig. 20) has described and illustrated a fragmentary specimen from the Permian of Japan that he regarded as conspecific, and it is about 115 mm. long and at its larger end is about 22 mm. in diameter. This last author also proposed the name *D.* [(*Antalis*)] *neornatum* for another large scaphopod from the Permian of Japan. It is incomplete both orad and apicad, but the preserved portion of it "measures about 190 mm. in length: [and] it seems to have been perhaps more than 30 mm. longer posteriorly. . . . [Its] circumference is about 70 mm. near the anterior end." Also, J. B. Knight has recently written me that he has etched "large scaphopods" out of certain of the Permian limestones of Texas.

During the Cretaceous, scaphopods became abundant, but I have not been able to locate any references to very large Mesozoic or Cenozoic forms, possibly because I am relatively unfamiliar with the literature that deals with the invertebrates of those eras. Olsson (1942, pp. 80–82) states that "large Dentalia are common in certain Tertiary formations in tropical America," but in the discussion of the largest form he describes, *D.* (*Fissidentalium*) *buricum* Olsson of southeastern Costa Rica, he gives the maximum diameter of incomplete specimens as 15 mm. and estimates that "a full-grown shell would have a length of about 100 millimeters." He also mentions that "another large *Dentalium*, perhaps allied to this species, occurs in the Pleistocene" of nearby southwestern Panama. Furthermore, Pilsbry and Brown (1917, p. 37, pl. 5, fig. 8) have illustrated and described as *D.* (*F.?*) *solidissimum* P. and B. a fragment from the Miocene ["Oligocene"] of northern Colombia that is said to have a maximum diameter of 15.8 mm.; and Weisbord (1929, p. 26) states that in the same general horizon and locality, shells of this species attain an "approximate total length [of] 150 mm." However, as concluded by Bellini (1909, p. 220) in his review of the Tertiary and Quaternary scaphopods of Italy, the largest forms known all seem to be from the Late Paleozoic.

Through the courtesy of Professor J. Wyatt Durham, I have been able to study the diversified collection of Tertiary and Recent scaphopods in the Museum of Paleontology of the University of California at Berkeley. None of the specimens is particularly large; but it should perhaps be noted that as pointed out by Pilsbry and Sharp (1897–1898, p. xi) "occasionally, though rarely, shells are found bored by rapacious gastropods." Such borings were observed in only one of the more than 200 Recent specimens examined but were present in two from the Upper Eocene Cowlitz formation of Washington.

Very little work seems to have been done on the taxonomy of scaphopods since the

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EXPLANATION OF PLATE 76

FIGS. *1–4*—*Dentalium* (*Antalis*) *raymondi* (Young). Lateral (fig. *1*) and dorsal (fig. *2*) views of an almost complete specimen ×¾; and enlargements of adoral (fig. *3*) and moderately adapical (fig. *4*) portions of the dorsal surface of the same individual, ×1½ and 3, respectively; from the upper part of the Millsap Lake formation about 5½ miles west of Millsap, Texas. Photographs retouched by Howard Webster.

Miller, Giant Pennsylvanian Scaphopod

publication of Pilsbry and Sharp's general study of 1897–1898. Those authors divided the class into the Dentaliidae and the Siphonodentaliidae. Clearly the specimen I am studying, and all of the species mentioned in the preceding paragraphs, belong in the former family, of which only one genus *Dentalium* is usually recognized. That genus has, however, been split into a number of subgenera, to which some authors have accorded generic rank. As noted by Hayasaka (1925, p. 23) these forms are "in the main subdivided on the basis of the sculpture of the shell surface, although the character of the slits on the posterior end of the shells that have served for many scientists as the basis of the classification are not yet entirely rejected. Moreover, the curvature of the shell, the degree of the tapering or attenuation of the shells as well as the outline of the shells in transverse section are also features important for classification."

For the most part, at least, the Late Paleozoic scaphopods seem to have been referred to three subgenera: *Dentalium s. s.*, *Antalis* [=*Entalis* of authors[2]], and *Plagioglypta*. According to Pilsbry and Sharp (1897–1898, p. xxx) *Plagioglypta* can be differentiated from the other two by the fact that its shell bears "no longitudinal sculpture." These authorities (Pilsbry and Sharp, p. xxix) recognize that "much difficulty will be found in distinguishing *Dentalium* restricted" from *Antalis*, and they state that they "would scarcely have segregated them as subgenera had they not already been named." However, if we follow the prevailing custom and regard as of paramount importance the surface markings of the shell, we can in most cases refer specimens to one or the other of these two subgenera with a reasonable degree of assurance. That is, in the former the shell is "decidedly polygonal or ribbed, at least near the apex"; and in the latter it is "sculptured with longitudinal ribs or striae at least in the young, often without longitudinal sculpture in adults, or only so sculptured near the apex" (Pilsbry and Sharp, 1897–1898, pp. xxx, 37). As thus interpreted, the subgenus *Antalis* includes the Pennsylvanian form under consideration, for its longitudinal markings are more of the nature of striae than ribs. *Prodentalium* Young, 1942, with *P. raymondi* Young of the Pennsylvanian as genotype, should therefore be suppressed as a synonym of *Antalis*, which has priority.

[2] As pointed out by Pilsbry and Sharp (1897–1898, pp. 37, 38, 245–246) *Entalis* Gray, 1847, (scaphopods) is preoccupied by *Entalis* Sowerby, 1839 (polychaete worms), which in turn may have to be suppressed as a synonym of *Pyrgopolon* Montfort, 1808. *Antalis* is generally ascribed to H. and A. Adams, who used it first in 1854. However, as noted by Pilsbry and Sharp, as early as 1846 Herrmannsen mentioned (and briefly diagnosed) it "as a name for smooth *Dentalia*, no type species having been given"; and therefore it seems likely that it should be credited to him, though Neave in his *Nomenclator Zoologicus* cites only the publication of the Adams brothers and not that of Herrmannsen. J. B. Knight of the U. S. National Museum has written me that he and his colleagues, H. A.. Rehder and J. P. E. Morrison, believe the "first valid publication" of *Antalis* to be that of H. and A. Adams, but Sherborn in his *Index Animalium* indicates that Herrmannsen validated it. Fortunately, the concept of the genus will apparently remain the same regardless of who is recognized as its author.

DENTALIUM (ANTALIS) RAYMONDI (Young)

Plate 76, figures 1–4

? *Dentalium* sp. GIRTY, 1903, U. S. Geol. Surv. Prof. Pap. 16, pp. 251, 261, 452.

Prodentalium raymondi YOUNG, 1942, Jour. Paleontology, vol. 16, pp. 120–121, pl. 20, figs. 3–6, 8, 12.

The large specimen being studied is a well preserved testiferous individual, which however is slightly distorted and locally crushed. It appears to be essentially complete adapically but not adorally, and the overall length of the preserved portion of it measures about 252 mm. At the posterior end of this specimen, the shell, which is broadly elliptical in cross section, is about 9 mm. high and about 10 mm. wide. It is gradually and regularly expanded orad, and its maximum width and height measure some 35 mm. and 30 mm., respectively. The shell is slightly but distinctly curved longitudinally, with the ventral side convex and the dorsal concave, but due to the fact that the holotype was broken and somewhat distorted during fossilization, the amount of its curvature can not be determined accurately.

The surface of the shell bears fine longi-

tudinal and transverse markings. In the adapical part of the holotype, the longitudinal striae are more pronounced than the transverse. However, during ontogenetic development the relative prominence of these two sets of markings was gradually reversed, and no trace of the longitudinal ones can be discerned on the adoral fourth of the specimen under consideration. The transverse markings are of somewhat variable size and prominence, and the surface of the shell has an indistinct coarse annulation, suggesting that the rate of its growth was not constant. The growth lines are rather strongly inclined to the long axis of the conch, sloping orad from the venter.

The test is thick, and it is composed of numerous thin concentric layers. At the adoral end of the specimen being studied, its thickness measures about 5 mm. along the dorsum and about 4 mm. along the venter and on the lateral zones is intermediate between these two extremes. At a break slightly apicad of the mid-length of this specimen, the dorsal portion of the conch is about 3 mm. thick.

The extreme adapical portion of this individual appears to have been very slightly distorted and there is a small break in its left ventrolateral zone. The margins of the anal orifice (unlike the growth lines and presumably, therefore, the oral aperture) are essentially transverse to the long axis of the conch. The posterior surface of the specimen is somewhat irregular and not quite bilaterally symmetrical; its general appearance suggests that it resulted from etching or solution rather than breakage, and presumably the original apex of the shell was absorbed by the mantle during ontogenetic development. There seems to be no indication of slits or notches around the margins of the anal orifice or of a supplemental tube of any appreciable length.

Remarks.—Comparable portions of this specimen are strikingly similar to the fragments from the Magdalena group of northern New Mexico on which Young based his species; and all of them indicate a shell of about the same general size. Young's specimens show that, as in modern scaphopods, there is a considerable amount of variation within the species.

S. G. Tuell has loaned me a second specimen from the same horizon and locality as the large one just described in detail. It was assembled from fragments and is crushed and distorted. It represents the adoral 60 mm. or so of a large shell which (in its present crushed state) attains a maximum width of a little more than 40 mm. and a corresponding height of some 25 mm. The test, which has a maximum thickness of about 7 mm. near the broken adapical end of the specimen, becomes progressively thinner adorally, and the apertural margins are therefore wedge-shaped and are relatively thin. The test is marked externally by growth lines of varying prominence, is smooth internally, and is composed of numerous thin concentric layers. Presumably during ontogenetic development its thickness was increased by the addition of layers of calcium carbonate to the inner surface of the shell.

Young placed in the synonymy of his species Girty's "*Dentalium* sp." from the Hermosa formation of southwestern Colorado, but in his discussion he referred to it as a "similar form," leaving doubt as to how close he considered the relationship to be. Girty's description is very brief and is not accompanied by illustrations. Young apparently did not restudy the Colorado specimens, nor have I, and therefore there is uncertainty as to whether or not they are specifically identical with the types of *D.* (*A.*) *raymondi.*

The more significant characters of this species are believed to be its large size, slight longitudinal curvature, elliptical cross section, longitudinal striae, and rather strongly oblique growth lines. Insofar as I have been able to ascertain, these serve to differentiate it readily from all other described forms. Superficially it seems to resemble *D.* (*A.*) *ornatum* de Koninck of the Viséan of Belgium and *D.* (*A.*) *neornatum* Hayasaka of the Permian of Japan; however, as might be expected because of the dissimilarity in age, neither of these is sufficiently close to the one under consideration to justify detailed comparisons. Most of the scaphopods known from the Pennsylvanian are fragments of relatively small forms, and comparisons with them would be superfluous for the great difference in size alone is sufficient to distinguish them.

Occurrence.—R. J. Stark has written me that the two specimens described above came from a shale member of the upper part of the Millsap Lake formation just below the Goen limestone (that is, between the Goen and the Santo limestones) about 300 feet west of the Millsap-Brazos road, a tenth of a mile south of the Goen cemetery, and about 5½ miles west of Millsap, in the extreme eastern part of Palo Pinto County, Texas (Texas University locality 181-T-5).

Repository.—Private collection of S. G. Tuell of Plainville, Connecticut.

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JOURNAL OF PALEONTOLOGY, VOL. 23, NO. 4, PP. 392–394, PL. 77, 2 TEXT FIGS., JULY 1949

TWO NEW SPECIES OF GASTROPODS FROM THE MIDDLE EOCENE OF CALIFORNIA

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IN AN earlier paper in this journal the present authors (1939) described *Campanile greenellum* from beds referred to the Martinez, Lower Eocene of California. Since then another large species of Cerithioid, occurring in beds referred to the Domengine, middle Eocene of California, has been discovered. It is described as new in the present paper.

The type of this new species was collected on Media Agua Creek, Kern County, California, by Earl Dillon, geologist with the Tidewater Associated Oil Company. Additional specimens were discovered by Dr. R. L. Hewitt, geologist with the same company, some ten miles to the south. At this southern locality a new species of naticoid was collected; it also is described in the present paper.

Several species of corals occurring with these new species have been described by Durham (1942). *Spiroglyphus tinajasensis* Hanna and Hertlein (1941) occurs with these at some localites.

At the locality on Media Agua Creek, the *Campanilopa* and the corals occurred in a pebble conglomerate which has weathered down to a fairly smooth slope; the fossils were scattered over the surface. There are two isolated outcrops on the upper drainage of Carneros Creek, one on the south side of the road and one on the north. These are hard sandstones and contain many fossils but extraction of well preserved specimens is accidental. *Campanilopa* at this locality is especially adherent to the matrix but some of the individuals are very large, the length being as much as 300 mm. or more. The fossils and the sedimentary beds in which they occur appear to have been deposited in tropical or subtropical, shallow, marine waters.

The two species here described as new bear considerable resemblance to forms occurring in the Lutetian, middle Eocene of France. Additional information is thus furnished concerning possible contemporaneity of the sedimentary beds containing these species with those containing similar fossils in Europe.

Genus CAMPANILOPA Iredale

Campanilopa IREDALE, Proc. Malacol. Soc. London, Vol. 12, November, 1917, pp. 322, 325. Proposed "for the species *Cerithium giganteum*, Lamarck (Ann. Mus. Hist. Nat. Paris, Vol. III, March, 1804, p. 439)." For illustrations see Favre, J., Cat. Illustr. Coll. Lamarck. Mus. Hist. Nat. de Genève, 1918, Moll. Trach. Foss., pl. 12, figs. 200, 201. [Specimen illustrated in fig. 201 cited as from "Grignon." "Lutécien." Specimen illustrated in fig. 200 was originally cited by Lamarck as occurring among Recent species. Deshayes, as mentioned by Favre, pointed out that this was due to a mistaken locality; the specimen is an Eocene fossil.]

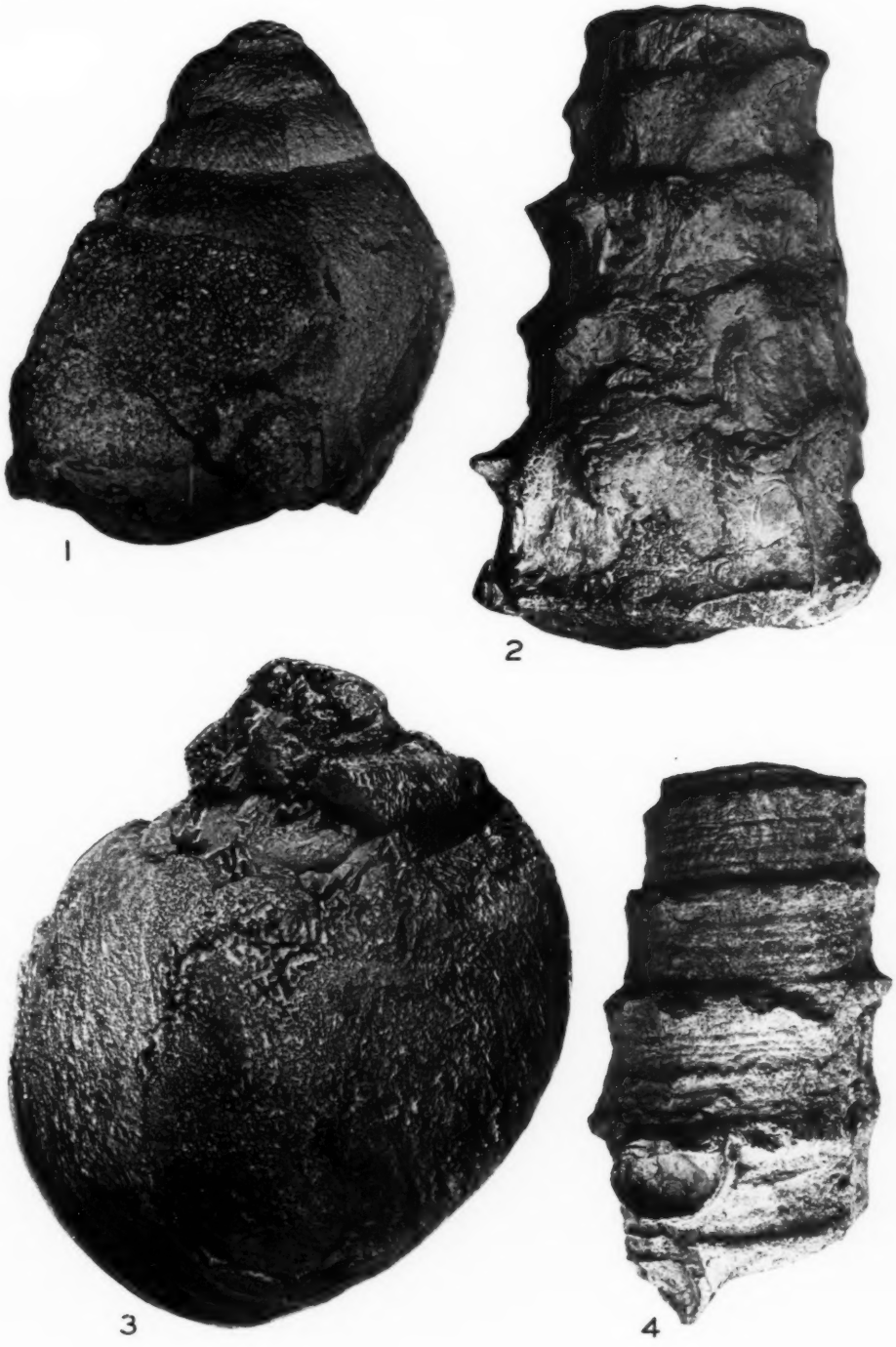
In our earlier paper we used the genus name *Campanile* Bayle for the species

EXPLANATION OF PLATE 77

Specimens in the type collection of the department of Paleontology, California Academy of Sciences.

FIGS. *1*, *3*—*Ampullella hewitti* Hanna and Hertlein, n. sp. From Loc. 32388 A (C.A.S.), about 810 feet south and 2770 feet east of the NW. corner of sec. 18, T. 29 S., R. 20 E., M.D.B. & M., Kern County, California, Domengine, middle Eocene. Fig. *1*, Paratype, No. 9431; height, 74.3 mm. The spire on this specimen is higher than usual for this species. Fig. *3*, Holotype No. 9430; height, 95 mm. (p. 393)

2, *4*—*Campanilopa dilloni* Hanna and Hertlein, n. sp. From Loc. 30667 (C.A.S.), from SW. corner of sec. 27, T. 28 S., R. 19 E., M.D.B. & M., through the NE. ¼ of SE. ¼ of sec. 28, T. 28 S., R. 19 E., M.D.B. & M., south side of headwaters of Media Agua Creek, Kern County, California. Basal fossiliferous *Spiroglyphus* sands, middle Eocene. Fig. *2*, Paratype, No. 9428; height, 81 mm. Fig. *4*, Holotype, No. 9425, height, 72.5 mm. (p. 393)



Hanna and Hertlein, Middle Eocene Gastropods

greenellum. The type of the genus *Campanile* by virtual original designation is *Cerithium laeve* Quoy and Gaimard and that species was definitely designated as type by Crosse (1887), "*Campanile*, Bayle (type: *C. laeve*, Quoy et Gaimard)." Iredale later discussed the genus and stated that he believed *Cerithium giganteum* Lamarck to be quite distinct from the group of *C. laeve*. He therefore proposed the genus *Campanilopa* for *C. giganteum*. A study of the nomenclature of *C. laeve*, the type of *Campanile*, convinced him that it should be renamed and he accordingly proposed the name *Campanile symbolicum* for it.

Whether or not the groups of *Cerithium laeve* and *C. giganteum* are congeneric may be open to question and is not discussed in the present paper. Our new species is certainly congeneric with *C. giganteum*. It appears that it would cause less confusion to use the genus name *Campanilopa* for our new species, at least until the relationshlp of the two groups is better known and generally accepted.

Other names have been proposed for genera or subgenera of fossil species of "*Campanile*," such as *Portoricia* Maury (1920), type, *Campanile* (*Portoricia*) *laricum* Maury. *Perucerithium* Olsson (1929), type, *Cerithium* (*Perucerithium*) *restinense* Olsson, superficially similar to some species of *Campanilopa*, is said to lack plaits on the columella.

Wrigley (1940) has recently given very useful notes on several species of "*Campanile*" with special reference to those of England.

CAMPANILOPA DILLONI Hanna and Hertlein, n. sp.

Plate 77, figures 2 and 4; text figure 1

Shell elongate, 4 whorls present (shell incomplete on type); whorls rather flat-sided but slightly concave; top of each whorl sculptured with a projecting carina which bears about 14 to 16 pointed nodes; the sides of the whorls are ornamented by about a half dozen spiral lirae. Paratypes in longitudinal section reveal the presence internally of two strong plaits on the columella and a rounded ridge on both the top and bottom of the cavity. Dimensions of holotype: height (incomplete), 72.5 mm.; diameter, 44.0 mm. Some specimens, poorly preserved, indicate a height of approximately 300 mm.

Holotype, No. 9425 and paratypes Nos. 9428, 9429 (Calif. Acad. Sci. Dept. Paleo. Type Coll.), from Loc. 30667 (C.A.S.), SW. corner of sec. 27, T. 28 S., R. 19 E., M.D.B. & M., through the NE. ¼ of SE. ¼ of sec. 28, T. 28 S., R. 19 E, M.D.B. & M., south side of headwaters of Media Agua Creek, Kern

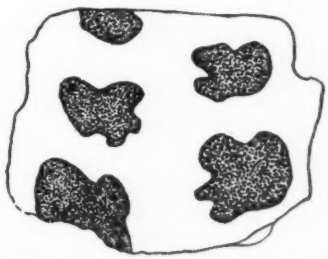


FIG. *1—Campanilopa dilloni* Hanna & Hertlein, n. sp. Paratype, No. 9429; height, 33.3 mm. View showing section of one whorl and revealing the presence of plaits on the columella.

County, California. Earl Dillon, collector, 1940. Basal fossiliferous *Spiroglyphus* sands, Middle Eocene. At this locality *Spiroglyphus tinajasensis* Hanna & Hertlein; *Rhynchopygus californicus* (F. M. Anderson); and *Turritella lawsoni* Dickerson occur just below the *Campanilopa*.

Campanilopa dilloni bears considerable resemblance to *Campanile incomptum* Dixon (Deshayes 1864) from the Lutetian of the Paris basin, France, but differs in that it is less tapering and the nodes are confined more to the carina.

AMPULLELLA HEWITTI Hanna and Hertlein, n. sp.

Plate 77, figures 1 and 3; text figure 2

Shell very large, globose, symmetrical; whorls probably six, rounded not shouldered, suture impressed, not channelled; aperture evenly rounded, not angular; outer lip thickened slightly but not recurved; imperforate, but with a slight depression in the callus at the position of the umbilical chink; columella thickened evenly; sculpture consisting of light lines of growth only. Height of holotype, 95 mm.; diameter, 78 mm.

Holotype, No. 9430 and paratypes Nos. 9431, 9432, 9433 (Calif. Acad. Sci. Dept. Paleo. Type Coll.), from Loc. 32388A (C.A.S.), from hard sandstone on the north side of road from Carrizo plains to Carneros Creek about 810 feet south and 2770 feet east of the NW. corner of sec. 18, T. 29 S., R. 20 E., M.D.B. & M., Kern County, California. G. D. Hanna, R. L. Hewitt and J. W. Olson, colls., December, 1946. Domengine, Middle Eocene. Associated with this

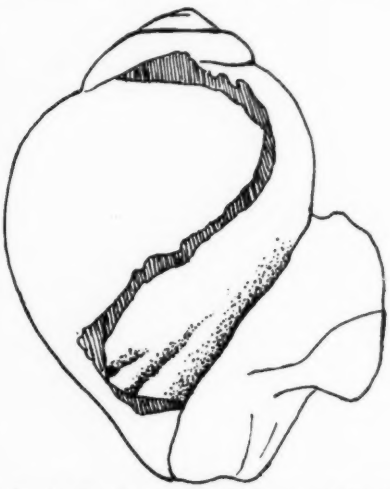


FIG. 2—*Ampullella hewitti* Hanna and Hertlein, n. sp. Paratype, No. 9433; height, 82.9 mm. View showing especially the rounded whorls and the faint depression in the umbilical area.

new species are: *Anomia* sp.; *Spondylus carlosensis* F. M. Anderson; *Campanilopa dilloni* Hanna and Hertlein, new species; *Cernina* (*Eocernina*) *hannibali* (Dickerson); *Cowlitzia* sp.; *Fusiturricula* cf. *crenatospira* (Cooper); *Spiroglyphus tinajasensis* Hanna & Hertlein; *Tejonia moragai* (Stewart); *Terebellum* cf. *californicum* Vokes; *Rhynchopygus californicus* (F. M. Anderson).

This large species is common at the type locality but the hardness of the matrix rock makes extraction of specimens difficult. However, the characters in the series obtained show little variation from the holotype described above. The symmetry of the shell indicates that it belongs with *Ampullella* Cox (Cox 1931), the type of which is *Ampullaria depressa* Lamarck (Favre 1918), rather than with such groups as *Crommium* Cossmann, *Cernina* Gray or *Amaurellina* Bayle which are shouldered or otherwise asymmetrical.

Vokes (1939) described *Ampullella schencki* from the Eocene (Avenal Sand) several miles northwest of the locality from which *A. hewitti* was collected. This Avenal species is small (maximum length recorded, 20 mm.), the spire has more obtuse angles, the whorls are slightly shouldered and the suture is described as "channeled."

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An extensive paper by Geneviève Delpey entitled "Histoire du Genre Campanile" (Ann. de Paleo., Vol. 29, 1941, pp. 3–25, 19 figs. in text, 1 table), was not received until after the manuscript of the present paper was submitted for publication. *Campaniloţa*, considered by Delpey to be a subgenus of *Campanile*, was cited as ranging questionably from the Santonian and certainly from the Danian, Upper Cretaceous, to Auversian, Upper Eocene, and questionably to the Stampian, Oligocene.

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BIBLIOGRAPHY AND INDEX TO NEW GENERA, SPECIES, AND VARIETIES OF FORAMINIFERA FOR THE YEAR 1947

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THE FOLLOWING bibliography for the year 1947 lists 250 papers devoted partly or exclusively to Foraminifera. Valuable help in compiling the data for this bibliography and index has been received from, and cordial thanks are herewith expressed to Dr. Paul L. Applin, Dr. H. von Bandat, Dr. Chalmer L. Cooper, Dr. Joseph A. Cushman, Dr. H. J. Finlay, Dr. Rud. Grill, Dr. Heinrich Hiltermann, Dr. H. J. MacGillavry, Miss Angelina R. Messina, Dr. Cameron D. Ovey, Dr. Manfred Reichel, Dr. Hubert G. Schenck, Mr. J. Sigal, Dr. Aug. Spicher, Miss Ruth Todd, Dr. S. W. Tromp, and Dr. M. Vasicek.

The Index to new genera, species, varieties and subspecies of Foraminifera for the year 1947 lists as new: 1 family (emend.), 3 subfamilies, 20 genera, 341 species, 38 varieties, subspecies or formae, 17 *nomina nova*, 7 *nomina nuda* (regarded as such at the present time) 11 homonyms of which 5 have been changed during 1947, and 68 forms to which the *nomenclatura aperta* was applied.

The six homonyms erected during 1947 and not yet given new names, are as follows.

Nodosaria mitis (Terquem and Berthelin) var. *conica* Payard
Nodosaria paucicosta Payard
Nodosaria tenuistriata Payard
Pseudocitharina fasciata Payard var. *aalense* Payard
Trocholina intermedia Henson
Valvulineria lobata Cushman and Applin

Information regarding these homonyms is given in the Index. Nomenclatural remarks are given for *Sigmoilina cushmani* Finlay, *Spiroloculina carinata* Y. LeCalvez, *Spiroloculina ubiqua* Y. LcCalvez, and *Valvulineria gracillima* ten Dam.

In Lit. No. 61 of the following bibliography, Cushman and Todd again describe and figure (p. 10, pl. 1, fig. 15) *Trochammina pacifica* Cushman var. *simplex* Cushman and McCulloch, 1939, although we noted in 1942 (Jour. Paleontology, vol. 16, p. 490) this homonym, which is preoccupied by Friedberg, 1902. *Lagena sulcata* (Walker and Jacob) var. *apiculata* Cushman, 1913, mentioned in the same paper by Cushman and Todd (and also in Cushman and Gray), 1946 (Spec. Publ. No. 19, Cushman Lab. Foram. Res. p. 20) is preoccupied by Reuss, 1851.

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Ammobaculites advenus Cushman and Applin, Contr. Cushman Lab. Foram. Res., vol. 23, p. 53, pl. 13, fig. 1. Upper Cretaceous, Texas.
——— *agrestis* Cushman and Applin, *ibid.*, vol.

23, p. 53, pl. 13, figs. 2, 3. Upper Cretaceous, Texas.

——— *chiranus* Cushman and Stone, Spec. Publ. No. 20, Cushman Lab. Foram. Res., p. 3, pl. 1, fig. 5. Eocene, Northwest Peru.

——— *gratus* Cushman and Applin, Contr. Cushman Lab. Foram. Res., vol. 23, p. 54, pl. 13, fig. 4. Upper Cretaceous, Texas.

——— *humei* Nauss, Jour. Paleont., vol. 21, p. 333, pl. 48, fig. 1. Upper Cretaceous, Alberta, Canada.

——— *paleocenicus nom. nov.*, Cushman, Contr. Cushman Lab. Foram. Res., vol. 23, p. 77. Paleocene, Alabama. New name for: *A. midwayensis* Cushman, 1940 (non Plummer, 1933), Contr. Cushman Lab. Foram. Res., vol. 16, p. 52, pl. 9, figs. 1, 2.

——— *tyrrelli* Nauss, Jour. Paleont., vol. 21, p. 333, pl. 48, fig. 2. Upper Cretaceous, Alberta, Canada. (Note: Nauss refers in the synonymy to *Ammobaculites coprolithiformis* Cushman, 1927, without citing bibliographic references.)

Ammodiscus anguillae Höglund, Zool. Bidr. Uppsala, vol. 26, p. 128, pl. 28, fig. 8; pl. 29, fig. 4; text figs. 101, 105, 109. Recent, off Anguilla, Caribbean Sea, 350–400 fathoms. For: *Trochammina incerta* Goës, 1882 (non d'Orbigny, 1839), K. Svensk. Vet. Akad. Handl., vol. 19 (4), p. 136, pl. 11, figs. 405, 406; for: *?Ammodiscus incertus* Brady, 1884, (non d'Orbigny, 1839), Challenger Rept., Zool., vol. 9, p. 330, pl. 38, figs. 1, 3; and for: *?Ammobaculites incertus* Cushman, 1918 (non d'Orbigny, 1839), U. S. Nat. Mus., Bull. 104, pt. 1, p. 95, pl. 39, fig. 2.

——— *catinus* Höglund, *ibid.*, vol. 26, p. 122, pl. 8, figs. 1, 7; pl. 28, figs. 19–23; text figs. 82–84, 105–107, 109. Recent, Gullmar Fjord, Sweden, 58–118 meters.

——— *flavidus* Höglund, *ibid.*, vol. 26, p. 127, pl. 28, figs. 1, 2; pl. 29, fig. 3; text figs. 99, 100, 108. Recent, Pacific, 660–1132 fathoms.

——— ——— ——— var. *scabrata* Höglund, *ibid.* vol. 26, p. 128, pl. 28, figs. 3, 4; text figs. 105, 106, 109. Recent, Pacific, 660–1132 fathoms.

——— *intermedius* Höglund, *ibid.*, vol. 26, p. 126, pl. 28, figs. 9, 10; text figs. 93, 105, 109. Recent, off Sweden, 60–200 m. For: *Ammodiscus tenuis* Goës, 1894 (non Brady, 1881), *K. Svensk. Vet. Akad. Handl.*, vol. 25, No. 9, p. 31, pl. 6, figs. 240, 241.

——— *minimus* Höglund, *ibid.*, vol. 26, p. 124, pl. 8, figs. 5, 10; text figs. 90, 105, 110. Recent, Skagerak, Sweden, 196–352 meters.

——— *planorbis* Höglund, *ibid.*, vol. 26, p. 125, pl. 8, figs. 4, 9; pl. 28, figs. 13, 14; text figs. 91, 105, 109. Recent, Skagerak, Sweden, 199–700 meters.

——— *planus* Höglund, *ibid.*, vol. 26, p. 123, pl. 8, figs. 2, 3, 8; pl. 28, figs. 17, 18; text figs. 85–89, 105, 106, 109. Recent, Gullmar Fjord, Sweden, 24–79 meters. (Note: Species-name preoccupied by Loeblich, 1946, Jour. Paleont., vol. 20, p. 133, pl. 22, fig. 2, and therefore, changed to: *Ammodicsus gullmarensis nom. nov.* Höglund, 1948, Contr. Cushman Lab. Foram. Res., vol. 24, p. 45.)

AMMOSCALARIA gen. nov. Höglund, *ibid.*, vol. 26, p. 151. Family: not given. (Lituolidae). Genotype: *Haplophragmium tenuimargo* Brady, 1884, Challenger Rept., p. 303, pl. 33, figs. 13–16. Recent.

Angulogerina fluens Todd (MS), in: Cushman and Todd, Contr. Cushman Lab. Foram. Res., vol. 23, p. 67, pl. 16, figs. 6, 7. Pliocene ?, Alaska. (Note: This species was also published as a *new* species by Todd, 1948, in: Cushman and McCulloch, 1948, Allan Hancock Pacific Exped., vol. 6, No. 5, p. 288, pl. 36, fig. 1, Recent, Pacific, off Alaska, 2 fathoms.)

——— *astoriensis* Cushman, Stewart and Stewart, Oregon Dept. Geol. Min. Industr., Bull. No. 36, p. 19, pl. 2, figs. 16, 17 (published May 28, 1948).

Anomalina chirana Cushman and Stone, Cushman Lab. Foram. Res., Spec. Publ. No., 20, p. 25, pl. 4, fig. 1. Eocene, NW Peru.

——— *obesa* Cushman and Applin, Contr. Cushman Lab. Foram. Res., vol. 23, p. 55, pl. 13, fig. 7. Upper Cretaceous, Mississippi.

——— *reinholdi* Cushman and ten Dam, *ibid.*, Contr. vol. 23, p. 59, pl. 14, fig. 7. Lower Pliocene, Holland. For: *Anomalina semipunctata* ten Dam and Reinhold (non Bailey, 1851), 1941, Mededeel, Geol. Sticht. Haarlem, series C, vol. V, No. 1, p. 61, pl. 5, fig. 1.

——— *solis* Nauss, Jour. Paleont., vol. 21, p. 333, pl. 49, fig. 9. Upper Cretaceous, Alberta, Canada.

——— *talaria* Nauss, *ibid.*, vol. 21, p. 334, pl. 48, figs. 11, 12. Upper Cretaceous, Alberta, Canada.

Aragonia tenara Finlay, N. Zealand Jour. Sci. and Technol., vol. 28, section B, p. 277, pl. 4, figs. 59–63. Paleocene, New Zealand.

Archaias vandervlerki de Neve, Bull. Bureau Mines and Geol. Surv. Indonesia, vol. 1, No. 1, p. 14, text figs. 1–4. Lower Miocene, East Borneo. For: *Orbiculina cf. adunca* Fichtel and Moll *in:* L. Rutten, 1917, Sammlung. Geol. Reichs-Mus. Leiden, N. F. vol. 2, p. 276, pl. 5, fig. 142; and for *? Orbiculina sp.* van der Vlerk, 1924, Wetensch. Mededeel. Dienst Mijnbouw Bandoeng, No. 1, p. 27, pl. 5, fig. 25.

Articulina ampulla Y. LeCalvez, Mem. Carte géol. France, p. 39, pl. 4, figs. 85, 86. Lutetian, Paris Basin, France.

——— *atlantica* Cushman, Contr. Cushman Lab. Foram. Res., vol. 23, p. 89, pl. 19, fig. 6. Recent, off Florida. 23 m depth.

——— *curta* Y. LeCalvez, Mem. Carte géol. France, p. 39, pl. 4, fig. 87. Lutetian, Paris Basin, France.

——— *elegans* Y. LeCalvez, *ibid.*, p. 39, pl. 4, figs. 83, 84. Lutetian, Paris Basin, France.

——— *ornaticollis* Y. LeCalvez, *ibid.*, p. 38, pl. 4, fig. 88. Lutetian, Paris Basin, France.

Asterigerina lutetiana ten Dam, Jour. Paleont., vol. 21, p. 586, text figs. 1–4. Lutetian, Netherlands.

——— *macfadyeni* ten Dam, *ibid.*, vol. 21, p. 396, text fig. 1. Upper Liassic, England.

Asterocyclina see *Discocyclina*

Bathysiphon flexilis Höglund, Zool. Bidr. Uppsala, vol. 26, p. 42, text figs. 10, 11. Recent, Färle Fjord, Sweden, 7 meters.

——— *vitta* Nauss, Jour. Paleont., vol. 21, p. 334, pl. 48, fig. 4. Upper Cretaceous, Alberta, Canada.

Bigenerina alternans Vasiček, Vest. Stat. geol. Ust. Ceskoslov., vol. 22, p. 244, pl. 1, figs. 3, 4. Cretaceous, Czechoslovaquia.

——— *burri* Finlay, N. Zealand Jour. Sci. and Technol., vol. 28, Sect. B, p. 267, pl. 4, figs. 38–42. Paleocene, New Zealand.

——— *minima* Vasiček, Vest. Stat. geol. Ustav. Ceskoslov., vol. 22, p. 245, pl. 2, fig. 9. Cretaceous, Czechoslovakia.

——— *nana* Vasiček, *ibid.*, vol. 22, p. 245, pl. 2, figs. 7, 8. Cretaceous, Czechoslovakia.

——— *paradoxa* Vasiček, *ibid.*, vol. 22, p. 244, pl. 1, figs. 5, 6. Cretaceous, Czechoslovakia.

——— *variabilis* Vasiček, *ibid.*, vol. 22, p. 246, pl. 1, figs. 10–12. Cretaceous, Czechoslovakia.

Bolivina astoriensis Cushman, Stewart and Stewart, Oregon Dept. Geol. etc., Bull. No. 36, p. 47, pl. 6, fig. 3. Miocene, western Oregon (published May 28, 1948).

——— *barnwelli* Finlay, N. Zealand Jour. Sci. Techn., vol. 28 (B), p. 280, pl. 5, figs. 73–75. Upper Miocene, New Zealand.

——— *basisenta* Cushman and Stone, Cushman Lab. Foram. Res., Spec. Publ. No. 20, p. 15, pl. 2, fig. 20. Eocene, NW Peru.

——— *chirana* Cushman and Stone, *ibid.*, Spec. Publ. No. 20, p. 16, pl. 2, fig. 22. Eocene, NW Peru.

——— *elkensis* Nauss, Jour. Paleont., vol. 21, p. 334, pl. 48, fig. 7. Upper Cretaceous, Alberta, Canada.

——— *lutosa* Finlay, N. Zealand Jour. Sci. Techn., vol. 28 (B), p. 280, pl. 5, figs. 76–79. Middle Miocene, New Zealand.

——— *maculata* Cushman and Stone, Cushman Lab. Foram. Res., Spec. Publ. No. 20, p. 17, pl. 2, fig. 21. Eocene, NW Peru.

——— *peruviana* Cushman and Stone, *ibid.*, Spec. Publ. No. 20, p. 16, p. 16, pl. 2, fig. 23 Eocene, NW Peru.

——— *pseudopunctata* Höglund, Zool. Bidr. Uppsala, vol. 26, p. 273, pl. 24, fig. 5; pl. 32, figs. 23, 24; text figs. 280, 281, 287. Recent, Gullmar Fjord, Sweden, 26–118 meters. For: *Bolivina punctata* Goës, 1894, *pro parte* (non d'Orbigny, 1839), K. Svensk. Vet. Akad. Handl., vol. 25, No. 9, p. 49, pl. 9, figs. 478, 480 (non figs. 475–477).

——— *subcompacta* Finlay, N. Zealand Jour. Sci. Techn., vol. 28 (B), p. 278, pl. 5, figs. 64–69. Upper Oligocene, New Zealand.

——— *zedirecta* Finlay, *ibid.*, vol. 28 (B), p. 278, pl. 5, figs. 70–72. Upper Oligocene, New Zealand.

Bolivinita glaessneri Finlay, N. Zealand Jour. Sci. Techn., vol. 28 (B), p. 277, pl. 4, figs. 55–58. Danian, New Zealand.

Bolivinopsis compta Finlay, *ibid.*, vol. 28 (B), p. 262, pl. 1, figs. 8–12. Paleocene, New Zealand.

——— *pulchella* Cushman and Stainforth, Contr. Cushman Lab. Foram. Res., vol. 23, p. 78, pl. 17, figs. 4, 5. Upper Eocene, Ecuador.

BORELOIDES gen. nov., Cole and Bermudez, Bull. Am. Paleont., vol. 31, No. 125, p. 9. Family: Alveolinellidae. Genotype: *Boreloides cubensis* Cole and Bermudez, 1947, *ut infra*. Eocene.

——— *cubensis* Cole and Bermudez, *ibid.*, vol. 31, No. 125, p. 9, pl. 2, figs. 1–9; pl. 7, fig. 5. Eocene, Cuba.

Bulimina acutangularis Cushman and Stainforth, Contr. Cushman Lab. For. Res., vol. 23, p. 80, pl. 17, fig. 13. Upper Eocene, Ecuador.

——— *chirana* Cushman and Stone, Cushman Lab. Foram. Res., Spec. Publ. 20, p. 14, pl. 2, fig. 13. Eocene, NW Peru.

——— *clava* Cushman and F. L. Parker, U. S. Geol. Surv. Prof. Pap. 210-D, p. 127, pl. 29, figs. 12, 13. Recent, Atlantic, off Chesapeake Bay, 788 fathoms. For: *? Bulimina aculeata* Brady, Parker and Jones, 1888 (non d'Orbigny, 1826), Trans. Zool. Soc. London, vol. 12, p. 220, pl. 43, fig. 8; and for: *Bulimina inflata* Cushman, 1922 (non Seguenza, 1862), U. S. Nat. Mus. Bull., 104, pt. 3, p. 93, pl. 21, fig. 1.

——— *decurtata* Cushman and Stainforth, Cushman Lab. For. Res., Contr., vol. 23, p. 80, pl. 17, fig. 11. Upper Eocene, Ecuador.

——— (*Desinobulimina*) *diversa* Cushman and Stone, *ibid.*, Contr., vol. 23, p. 57, pl. 14, figs. 1–3. Eocene, NW Peru. For: *Bulimina cf. ovata* Cushman and Stone, 1947 (non d'Orbigny, 1846), Cushman Lab. Foram. Res., Spec. Publ. 20, p. 14, pl. 2, fig. 14.

——— *lineata* Cushman and Stainforth, *ibid.*, Contr., vol. 23, p. 79, pl. 17, fig. 12. Upper Eocene, Ecuador.

——— *peruviana* Cushman and Stone, *ibid.*, Spec. Publ. 20, p. 14, pl. 2, fig. 16. Eocene, NW Peru.

——— *secaensis* Cushman and Stainforth, *ibid.*, Contr., vol. 23, p. 79, pl. 17, figs. 9, 10. Upper Eocene, Ecuador.

——— *serratospina* Finlay, N. Zealand Jour. Sci. Techn., vol. 28 (B), p. 283, pl. 5, figs. 83–86. Paleocene, New Zealand.

——— *subbortonica* Finlay, *ibid.*, vol. 28, (B), p. 283, pl. 6, figs. 97–103. Paleocene, New Zealand.

——— *venusae* Nauss, Jour. Paleont., vol. 21, p. 334, pl. 48, fig. 10. Upper Cretaceous, Alberta, Canada.

Buliminella chirana Cushman and Stone, Cushman Lab. Foram. Res., Spec. Publ. 20, p. 13, pl. 2, fig. 10. Eocene, NW Peru.

——— *glomerata nom. nov.* Cushman and F. L. Parker, U. S. Geol. Surv. Prof. Pap. 210-D, p. 66, pl. 17, fig. 2. Miocene, Colombia. New name for: *Buliminella pulchra* Tolmachoff, 1934 (non Terquem, 1882, *Bulimina*), Ann. Carnegie Mus., vol. 23, pl. 40, fig. 28.

——— *peruviana* Cushman and Stone, Cushman Lab. Foram. Res., Spec. Publ. 20, p. 12, pl. 2, figs. 7–9. Eocene, NW Peru.

BULIMINELLITA gen. nov. Cushman and Stainforth, *ibid.*, Contr., vol. 23, p. 78. Family not stated (Buliminidae, subfam. Turrilininae). Genotype: *Buliminellita mirifica* Cushman and Stainforth, 1947, *ut infra*. Upper Eocene.

——— *mirifica* Cushman and Stainforth, *ibid.*, Contr., vol. 23, p. 78, pl. 17, figs. 6–8. Upper Eocene, Ecuador.

Cancellina kobayashii Toriyama, Japan. Jour. Geol. Geogr., vol. 20, p. 74, pl. 16, figs. 15–22. Permian, Japan.

——— *tosayamensis* Toriyama, *ibid.*, vol. 20, p. 75, pl. 17, figs. 1–3. Permian, Japan.

Cassidulina insueta Cushman, Cushman Lab. Foram. Res., Contr., vol. 23, p. 92, pl. 20, fig. 10, Recent. Atlantic, off North Carolina, 72 m.

Ceratocancris hortalveus Finlay, N. Zealand Jour. Sci. Techn., vol. 28 (B), p. 286, pl. 6, figs. 87–90. Upper Eocene, New Zealand.

Chilostomella chilostomelloides Vasiček, Vest. Stat. geol. Ustav. Ceskoslov., vol. 22, p. 248, pl. 2, fig. 16. Upper Eocene (or lower Oligocene), Czechoslovakia.

——— *ovoidea* Reuss, 1850, var. *serrata* Cushman and Stone, Cushman Lab. Foram. Res., Spec. Publ. 20, p. 24, pl. 3, fig. 13. Eocene, NW Peru.

Chrysalogonium atlanticum Cushman, *ibid.*, Contr., vol. 23, p. 90, pl. 19, fig. 10. Recent, Atlantic, off South Carolina, 120 m.

Cibicides alaskensis Cushman and Todd, *ibid.*, Contr., vol. 23, p. 72, pl. 16, figs. 31, 32. Pliocene (?), Alaska.

——— *warreni* Cushman, Stewart and Stewart, Oregon Dept. Geol. etc., Bull. No. 36, p. 104, pl. 13, fig. 11. Eocene, western Oregon (published May 28, 1948).

Citharina lammersi nom. nov. ten Dam, Geol. en Mijnbouw, vol. 9, p. 174, text figs. 1, 2. Paleocene, Holland, New name for: *Vaginulina strigillata* Franke, 1927 (non Reuss, 1846), Danmarks Geol. Undersög., vol. 2, No. 46, p. 19, pl. 1, fig. 29; and for: *Citharina strigillata* ten Dam, 1944 (non Reuss, 1846), Mededeel. Geol. Sticht. Haarlem (C), vol. V, No. 3, p. 108, pl. 1, fig. 3.

Conicospirillina atlantica Cushman, Cushman Lab. Foram. Res., Contr., vol. 23, p. 91, pl. 20, fig. 8. Recent, Atlantic, off North Carolina, 35 m.

Conotrochammina depressa Finlay, N. Zealand Jour. Sci. Techn., vol. 28 (B), p. 260, pl. 1, figs. 1–4. Paleocene, New Zealand.

Cristellaria (*Robulus*) *teschi nom. nov.*, ten Dam and Reinhold, Jour. Paleont., vol. 21, p. 186. Middle Miocene, Holland. New name for: *Cristellaria americana* Cushman, 1918, var. *grandis* Cushman, 1920). Mededeel. Geol. Sticht. Haarlem (C), vol. V, No. 2, p. 54, pl. 3; pl. 9, fig. 9.

Crithionina goësi Höglund, Zool. Bidr. Uppsala, vol. 26, p. 36, pl. 3, figs. 1–6; text fig. 8. Recent Gullmar Fjord, Sweden, 35–55 m. For: *Placopsilina bulla* Goës, 1895 (non Brady, 1881), K. Svensk, Vet. Akad. Handl., vol. 25, No. 9, p. 28, pl. 6, figs. 211–215.

Cuneolina cylindrica Henson, Ann. Mag. Nat. Hist. (11), vol. 14, p. 627, pl. 14, fig. 7. Maestrichtian, N. Iraq (published June 1948).

——— *pavonia* d'Orbigny, 1839, var. *parva* Henson, *ibid.*, vol. 14, p. 624, pl. 14, figs. 1–6; pl. 17, figs. 7–12; pl. 18, figs. 12–14. Santonian, Egypt (published June 1948).

——— *walteri* Cushman and Applin, Cushman Lab. Foram. Res., Contr., vol. 23, p. 30, pl. 10, figs. 4, 5. Lower Cretaceous, Cuba.

Cyclammina lamella Vasiček, Vest. Stat. geol. Ustav. Ceskoslov., vol. 22, p. 243, pl. 2, fig. 13; text fig. 1. Eocene, Czechoslovakia.

Cymbalopora cushmani Cole and Bermudez, Bull. Am. Paleont., vol. 31, No. 125, p. 10, pl. 3, figs. 4–9 (not figs. 6–8); pl. 7, fig. 3. Eocene, Cuba.

Cystammina subgaleata Vasiček, Vest. Stat. geol. Ustav. Ceskoslov., vol. 22, p. 247, pl. 1, fig. 15; text fig. 3. Eocene and lower Oligocene, Czechoslovakia.

Dentalina inepta Cushman, Cushman Lab. Foram. Res., Contr., vol. 23, p. 83, pl. 18, fig. 5. Paleocene, Arkansas. For: *Dentalia sp. A* Cushman and Todd, 1946, *ibid.*, vol. 22, p. 51, pl. 8, fig. 10.

——— *insulsa* Cushman, *ibid.*, Contr., vol. 23, p. 84, pl. 18, figs. 6, 7. Paleocene, Arkansas. For: *Dentalina sp. B* Cushman and Todd, 1946, *ibid.*, Contr., vol. 22, p. 51, pl. 8, figs. 15, 16.

Desinobulimina, see *Bulimina*

Dicyclina atarensis Henson, Ann. Mag. Nat. Hist. (11), vol. 14, p. 622, pl. 14, fig. 8. Cenomanian, Arabia (published June 1948).

Discocyclina (*Asterocyclina*) *habanensis* Cole and Bermudez, Bull. Am. Paleont., vol. 31, No. 125, p. 16, pl. 5, figs. 1–6, Eocene, Cuba.

Discorbis pulchra Cushman, Cushman Lab. Foram. Res., Contr., vol. 23, p. 91, pl. 20, fig. 9. Recent, Atlantic, off North Carolina, 65 m.

——— *sanjuanensis* Cushman and Todd, *ibid.*, Spec. Publ. 21, p. 21, pl. 3, fig. 21. Recent, Pacific, off San Juan Island, Washington.

Doliolina iisaki Toriyama, Japan. Jour. Geol. Geogr., vol. 20, p. 71, pl. 16, figs. 9–12. Permian, Japan.

——— *tosensis* Toriyama, *ibid.*, vol. 20, p. 72, pl. 16, fig. 13. Permian Japan.

DUKHANIA gen. nov., Henson, Ann. Mag: Nat. Hist. (11), vol. 14, p. 614. Family Verneuilinidae, Subfam. Eggerellinae. Genotype. *Dukhania conica* Henson, 1947, *ut infra*. Lower and Middle Cretaceous (published June 1948).

——— *arabica* Henson, *ibid.*, vol. 14, p. 616, pl. 15, figs. 6, 7; pl. 17, figs. 1, 2. Lower Cretaceous, Arabia (published June 1948).

——— *conica* Henson, *ibid.*, vol. 14, p. 615, pl. 15, figs. 2, 4, 5, 8; pl. 18, figs. 2, 3. Lower and Middle Cretaceous, Arabia (published June 1948).

Eggerella arctica Höglund, Zool. Bidr. Uppsala, vol. 26, p. 193, pl. 16, fig. 4, text figs. 166–168. Recent, Greenland, 15–20 fathoms. For: *Verneulina pygmaea* Goës, 1894 (non Egger,

1857, *Bulimina*), K. Svensk Vet. Akad. Handl., vol. 25, No. 9, p. 33, pl. 7, figs. 262, 263; and for: *? Eggerella advena* (Cushman) in Cushman, 1937, Cushman Lab. Foram. Res., Spec. Publ. No. 8, p. 51, pl. 5, figs. 12–15 (*hic synonymia*).

Ehrenbergina healyi Finlay, New Zealand Jour. Sci. Techn., vol. 28 (B), p. 284 pl. 7, figs. 106–115. Middle Oligocene. New Zealand.

——— *trinitatensis* Cushman and H. H. Renz, Cushman Lab. Foram. Res., Spec. Publ. No. 22, p. 38, pl. 8, fig. 4. Upper Oligocene, Trinidad, B.W.I.

——— *willetti* Finlay, N. Zealand Jour. Sci. Techn., vol. 28 (B), p. 284, pl. 7, figs. 116, 117. Middle Oligocene, New Zealand.

Elphidiella arctica (Parker and Jones, 1864) var. *angulata* ten Dam, Geol. en Mijnbouw, vol. 9, p. 63. Pliocene, Holland. For: *Elphidiella hannai* ten Dam and Reinhold, 1941 (non Cushman and Grant, 1927). Mededeel, Geol. Sticht, Haarlem (C), vol. V, No. 1, p. 54, pl. 3, fig. 12.

Elphidium alaskense Cushman and Todd, Cushman Lab. Foram. Res., Contr., vol. 23, p. 65, pl. 15, figs. 18, 19. Pliocene?, Alaska.

Endothyra acuta Cooper, Jour. Paleont., vol. 21, p. 88, pl. 20, figs. 24, 30. Mississippian, Illinois.

——— *excentralis* Cooper, *ibid.*, vol. 21, p. 88, pl. 20, figs. 19–23. Mississippian, Illinois.

Entosolenia orbignyana (Sequenza, 1862) var. *perfecto-costata* Cushman and H. H. Renz, Cushman Lab. Foram. Res., Contr., vol. 23, p. 46, pl. 12, fig. 5, Upper Cretaceous, Trinidad, B.W.I.

EOFLABELLINA gen. nov. Payard, Foram. Lias sup. Détroit Poitevin, Thesis, Univ. Paris, p. 101. Family Lagenidae, Genotype: *Peneroplis d'orbignyi* Roemer, 1839, Verst. Norddeutsch. Oolithengeb., p. 47, pl. 20, fig. 31. Upper Liassic.

——— *chicheryi* Payard, *ibid.*, Thesis Univ. Paris, p. 108, pl. 6, figs. 18, 19. Toarcian, France.

——— *cuneiformis* Payard, *ibid.*, Thesis Univ. Paris, p. 110, pl. 6, fig. 12. Toarcian, France.

——— *mariei* Payard, *ibid.*, Thesis Univ. Paris, p. 108, pl. 6, fig. 11, 13–17. Toarcian and Aalenian, France.

——— *nucleata* Payard, *ibid.*, Thesis Univ. Paris, p. 107, pl. 6, fig. 10. Toarcian, France.

——— *terquemi* Payard, *ibid.*, Thesis Univ. Paris, p. 105, pl. 6, fig. 9, Aalenian, France.

EOPLACOPSILINA gen. nov., Payard, *ibid.*, Thesis Univ. Paris, p. 63. Family Placopsilinidae. Genotype: *Eoplacopsilina mariei* Payard, 1947, *ut infra*. Upper Liassic.

——— *mariei* Payard, *ibid.*, Thesis Univ. Paris, p. 63, pl. 1, figs. 24, 25. Toarcian, France.

Eoschubertella texana Thompson, Jour. Paleont., vol. 21, p. 161, pl. 31, figs. 1–8. Pennsylvanian, Texas.

Epistomina cretosa ten Dam, Geol. en Mijnbouw, vol. 9, p. 29, text fig. 6. Albian, Holland.

——— *fax* Nauss, Jour. Paleont., vol. 21, p. 335, pl. 48, figs. 15, 16. Upper Cretaceous, Alberta, Canada. (Note: "*Epistomina caracolla* in Wickenden, 1941" is placed into synonymy of this new species by Nauss, without giving exact bibliographic reference.)

Eponides mansfieldi Cushman, 1930, var. *oregonensis* Cushman, Stewart and Stewart, Oregon Dept. Geol. etc., Bull. No. 36, p. 48, pl. 6, fig. 4. Miocene, western Oregon (published May 28, 1948). For: *Eponides mansfieldi* Cushman and Parker 1931, (non Cushman, 1930), Cushman Lab. Foram. Res., Contr., vol. 7, p. 12, pl. 2, fig. 10.

Flintia damereyana Y. LeCalvez, Mém. Carte géol. France, p. 35, pl. 3, figs. 52–54. Lutetian, Paris Basin, France.

Gaudryina aequa Cushman, Cushman Lab. Foram. Res., Contr., vol. 23, p. 87, pl. 18, figs. 18–21. Recent, Atlantic, off South Carolina, 99 m.

——— *deadericki* Cushman, *ibid.*, Contr., vol. 23, p. 56, pl. 13, figs. 8–10. Upper Cretaceous, Arkansas.

——— *hectori* Nauss, Jour. Paleontology, vol. 21, p. 335, pl. 48, fig. 6. Upper Cretaceous, Alberta, Canada.

——— *hedbergi* Cushman, Cushman Lab. Foram. Res., Contr., vol. 23, p. 6, pl. 2, fig. 7. Upper Cretaceous, Venezuela.

Glandulina peelensis nom. nov. ten Dam, Jour. Paleon., vol. 21, p. 186. Paleocene, Holland. New name for: *Glandulina nitida* ten Dam, 1944, (non Neugeboren, 1850), Mededeel. Geol. Sticht. Haarlem, (C), vol. V, No. 3, p. 107, pl. 3, fig. 9.

——— *silvestrii* Selli, Riv. Ital. Pal. e Strat., vol. 53, p. 89, pl. 3, figs. 7–11; text fig. 1. Middle Pliocene, Italy.

Globigerina loetterli (*recte: loetterlei*) Nauss, Jour. Paleont., vol. 21, p. 336, pl. 49, fig. 11. Upper Cretaceous, Alberta, Canada.

Globobulimina auriculata (Bailey, 1851) forma *arctica* Höglund, Zool. Bidr. Uppsala, vol. 26, p. 254, text figs. 266, 267, 270, 271. Recent, Arctic, off Spitzbergen, Greenland.

——— ——— ——— forma *gullmarensis* Höglund, *ibid.*, vol. 26, p. 252, pl. 20, fig. 6; pl. 21, fig. 5; pl. 22, fig. 6; text figs. 258–265, 268, 269, 271. Recent, Gullmar Fjord, Sweden.

——— *glabra* Cushman and F. L. Parker, U. S. Geol. Surv., Prof. Pap. 210-D, p. 134, pl. 29, figs. 35, 36. Pliocene, Italy. For: ? *Bulimina pyrula* Brady, 1884, (non d'Orbigny, 1826), Challenger Rept., Zool., vol. 9, p. 399, pl. 50, figs. 7–10.

——— *pacifica* Cushman, 1927, var. *oregonensis* Cushman, Stewart and Stewart, Oregon Dept. Geol. etc., Bull. No. 36, p. 101, pl. 12, fig. 13. Eocene, western Oregon. (Note: The same new variety is already cited in the same paper on p. 78, and pictured on pl. 11, fig. 4, from the Upper Eocene of Oregon.)

GLOBOQUADRINA gen. nov. Finlay, New Zealand Jour. Sci. and Techn., vol. 28, (B), p. 290. Family: Globorotaliidae. Genotype: *Globorotalia dehiscens* Chapman, Parr, and Collins, 1934, Linn. Soc. Zool., Jour., vol. 38, p. 569, pl. 9, fig. 36. Middle Eocene, Upper Oligocene, and Miocene.

——— *primitiva* Finlay, *ibid.*, vol. 28 (B), p. 291, pl. 8, figs. 129–134. Middle Eocene, New Zealand.
——— *subdehiscens* Finlay, *ibid.*, vol. 28 (B), p. 291. (Described, but not figured.) Lower Miocene, New Zealand.
Globotruncana spinea Kikoine, Soc. géol. France, Comptes-rendus, p. 21, text figs. 1–3. Campanian, France.
Glomospira disca (*recte: discus*) Cooper, Jour. Paleont., vol. 21, p. 87, pl. 20, fig. 18. Mississippian, Illinois.
——— *glomerata* Höglund, Zool. Bidr. Uppsala, vol. 26, p. 130, pl. 3, figs. 8–10; text fig. 104. Recent, Gullmar Fjord, Sweden, 24–67 m.
Gypsina mastelensis Bursch, Schweiz. Paläont. Abhandl., vol. 65, p. 37, pl. 3, figs. 15, 19; pl. 5, fig. 4; text figs. 15-b, 17–19. Lower Oligocene, Great Kei Islands, Netherlands East Indies.
Gyroidina chirana Cushman and Stone, Cushman Lab. Foram. Res., Spec. Publ. 20, p. 23, pl. 3, fig. 4. Eocene, NW Peru.
——— *dissimilis* Cushman and H. H. Renz, *ibid.*, Spec. Publ. 22, p. 35, pl. 7, fig. 18. Upper Oligocene, Trinidad, B.W.I.

Hantkenina alabamensis Cushman, 1924, subsp. *compressa* Parr, Proc. Roy. Soc. Victoria, vol. 58, p. 46, text figs. 1–7. Upper Eocene, Victoria, Australia.
Haplophragmoides collyra Nauss, Jour. Paleontology, vol. 21, p. 337, pl. 49, figs. 2, 5. Upper Cretaceous, Alberta, Canada.
——— *fragile* Höglund, Zool. Bidr. Uppsala, vol. 26, p. 137, pl. 10, fig. 6; text figs. 115, 116. Recent, Gullmar Fjord, Sweden, 15–80 m.
——— *gigas* Cushman, 1927, var. *minor* Nauss, Jour. Paleont., vol. 21, p. 338, pl. 49, fig. 10. Upper Cretaceous. Alberta, Canada.
——— *linki* Nauss, *ibid.*, vol. 21, p. 339, pl. 49, fig. 7. Upper Cretaceous. Alberta, Canada.
——— *membranaceum* Höglund, Zool. Bidr. Uppsala, vol. 26, p. 136, pl. 10, fig. 5; text fig. 114. Recent, Gullmar Fjord, Sweden, 24–79 m.
——— *pusillum* Höglund, *ibid.*, vol. 26, p. 140, pl. 10, fig. 2; text fig. 113. Recent, Gullmar Fjord, Sweden, 35–57 m.
——— *rota* Nauss, Jour. Paleont., vol. 21, p. 339, pl. 49, figs. 1, 3. Upper Cretaceous, Alberta, Canada.
Heterostegina cubana de Cizancourt, Bull. Soc. géol. France (5), vol. 17, p. 518, pl. 25, figs. 4, 5. Eocene, Cuba (published September 1948).
Hippocrepina cylindrica Höglund, Zool. Bidr. Uppsala, vol. 26, p. 75, pl. 5, figs. 15–18. Recent, Skagerak, Sweden, 515 meters.
——— *depressa* Vasiček, Vest. Stat. geol. Ustav. Ceskoslov., vol. 22, p. 243, pl. 1, figs. 1, 2. Cretaceous, Czechoslovakia.
Hippocrepinella acuta Höglund, Zool. Bidr. Uppsala, vol. 26, p. 46, pl. 1, figs. 17–23. Recent, Gullmar Fjord, Sweden 22 m.
Hopkinsina mioindex Finlay, N. Zealand Jour. Sci. and Techn., vol. 28 (B), p. 282, pl. 5, figs. 80–82. Middle Miocene, New Zealand.

Hyperammina fragilis Höglund, Zool. Bidr. Uppsala, vol. 26, p. 71, text figs. 33–42. Recent, Skagerak, Sweden, 24 m. For: *Hyperammina elongata* Goës, 1894, pro parte, K. Svensk. Vet. Akad. Handl., vol. 25, No. 9, p. 17, pl. 4, figs. 57 and 58 only; for: *? Hyperammina friabilis* Goës, 1894, (non Brady, 1884), *loc. cit.*, p. 17, pl. 4, fig. 59; and for: *Jaculella obtusa* Goës, 1894, pro parte, *loc. cit.*, p. 20, pl. 5, fig. 91 only.

Karreriella baccata (Schwager, 1866) var. *alaskensis* Cushman and Todd, Cushman Lab. Foram. Res., Contr., vol. 23, p. 61, pl. 14, figs. 10, 11. Pliocene ?, Alaska.
KURNUBIA gen. nov. Henson, Ann. Mag. Nat. Hist., (11), vol. 14, p. 608. Family: Trochamminidae; Subfam. Tetrataxinae. Genotype: *Kurnubia palestiniensis* Henson, 1947, *ut infra*. Jurassic. (Published June 1948).
——— *palestiniensis* Henson, *ibid.*, vol. 14, p. 609, pl. 16, figs. 8, 11; pl. 18, figs. 10, 11. Jurassic; Palestine.

LABROSPIRA gen. nov. Höglund, Zool. Bidr. Uppsala, vol. 26, p. 141. Family not stated (Lituolidae). Genotype: *Haplophragmium crassimargo* Norman, 1892, Mus. Norman. pt. 8, Rhizopoda, p. 17. Recent, North Atlantic.
——— *kosterensis* Höglund, *ibid.*, vol. 26, p. 147, pl. 11, fig. 4; text figs. 130, 131. Recent, Koster Channel, Sweden, 200 meters. For: *Haplophragmium canariense* Goës, 1894, pro parte, (non d'Orbigny, 1839), K. Sevnsk. Vet. Akad. Handl., vol. 25, No. 9, p. 20, pl. 5, figs. 99–101 only.
Lacazina reicheli Bursch, Schweiz. Paläont. Abhandl., vol. 65, p. 17, pl. 1, figs. 8, 17; pl. 2, figs. 1–5; pl. 5, figs. 3, 5; text figs. 4, 5. Lower Oligocene, Great Kei Islands, Indonesia.
LAGENIDAE fam. emend. Parr, Proc. R. Soc. Victoria, vol. 58, p. 128. Includes the following genera: *Lagena* Walker and Boys, 1784; *Oolina* d'Orbigny, 1839, *Fissurina* Reuss, 1850, and *Parafissurina* Parr, 1947, *ut infra*.
Lenticulina chicheryi Payard, Foram. Lias sup. Détroit Poitevin, Thesis Univ. Paris, p. 87, pl. 7, fig. 7. Toarcian, France.
——— *danzayensis* Payard, *ibid.*, Thesis Univ. Paris, p. 88, pl. 7, fig. 6. Toarcian, France.
——— *gillardi* Payard, *ibid.*, Thesis Univ. Paris, p. 87, pl. 7, fig. 12. Toarcian, France.
——— *issleri* Payard, *ibid.*, Thesis Univ. Paris, p. 99, pl. 7, fig. 11. Toarcian, France.
——— *polylobata* (*recte: multilobata*) Payard, *ibid.*, Thesis Univ. Paris, p. 90, pl. 7, fig. 2. Toarcian, France.
——— *pseudopolygonata* Payard, *ibid.*, Thesis Univ. Paris, p. 89, pl. 7, figs. 21, 22 (non fig. 23). Aalenian-Toarcian, France.
——— ——— ——— var. *acuminata* Payard, *ibid.*, Thesis Univ. Paris, p. 90, pl. 7, fig. 23. Toarcian, France.
——— *toarcense* Payard, *ibid.*, Thesis Univ. Paris, p. 88, pl. 7, fig. 1. Toarcian, France.
Lepidocyclina weberi Bursch, Schweiz. Paläont. Abhandl., vol. 65, p. 55, pl. 3, fig. 3; pl. 4, fig. 4.

Middle Aquitanian, Great Kei Islands, Indonesia. (Note: The author's designation of the holotype, "pl. 12, fig. 1" is erroneous, as there is no plate 12 in this paper.)

Liebusella goësi Höglund, Zool. Bidr. Uppsala, vol. 26, p. 194, pl. 14, figs. 4–8; text figs. 177–179. Recent, Gullmar Fjord, Sweden, 116 m. For: *Bigenerina digitata* Goës, 1894 (non d'Orbigny, 1826), K. Svensk. Vet. Akad. Handl., vol. 25, No. 9, p. 38, pl. 7, figs. 324–343.

Lingulina mariei Payard, Foram. Lias. sup. Détroit Poitevin, Thesis Univ. Paris, p. 118, pl. 6, fig. 25. Toarcian, France.

——— *naheolensis nom. nov.* Cushman, Cushman Lab. Foram. Res., Contr., vol. 23, p. 18. New name for: *Lingulina minuta* Cushman, 1944, (non Franke, 1936), *ibid.*, Contr., vol. 20, p. 38, pl. 6, fig. 10. Paleocene, Alabama.

Lituotuba chirana Cushman and Stone, *ibid.*, Spec. Publ. 20, p. 2, pl. 1, fig. 6. Upper Eocene, NW Peru.

Lockhartia hunti Ovey, Ann. Mag. Nat. Hist. (11), vol. 13, No. 104, p. 572, pl. 10, figs. 1–6; pl. 11. Top Lower Eocene, British Somaliland.

Loxostomum deadericki Cushman, Cushman Lab. Foram. Res., Contr., vol. 23, p. 85, pl. 18, figs. 8–10. Paleocene, Arkansas.

——— ——— ——— var. *exilis* Cushman, *ibid.*, Contr., vol. 23, p. 85, pl. 18, figs. 11–13. Paleocene, Arkansas

——— *lammersi* Cushman and ten Dam, *ibid.*, Contr., vol. 23, p. 58, pl. 14, fig. 6. Lower Pliocene, Holland.

——— *truncatum* Finlay, N. Zealand Jour. Sci. Technol., vol. 28 (B), p. 280, pl. 6, figs. 91–96. Middle Miocene, New Zealand.

Marginulina villa Cushman, Cushman Lab. Foram. Res., Contr., vol. 23, p. 89, pl. 19, figs. 7, 8. Recent, Atlantic, off South Carolina, 120 m.

Marginulinopsis spinobesa Finlay, N. Zealand Jour. Sci. Techn., vol. 28 (B), p. 271, pl. 9, figs. 143–145. Middle Eocene, New Zealand.

Martinottiella eocenica nom. nov. Cushman and Bermudez, Cushman Lab. Foram. Res., Spec. Publ. No. 8-A, p. 48. Eocene, Cuba. New name for: *Listerella gracillima* Cushman and Bermudez 1937, in: Contr. Cushman Lab. Foram. Res., vol. 13, p. 6, pl. 1, figs. 27, 28; and in: Cushman Lab. Foram. Res., Spec. Publ. No. 8, p. 140, pl. 16, figs. 16, 17.

——— *paleocenica* Cushman, *ibid.*, Contr., vol. 23, p. 82, pl. 18, fig. 1. Paleocene, Alabama.

Massilina bella Y. LeCalvez, Mém. Soc. géol. France, p. 29, pl. 2, figs. 44, 45. Lutetian, Paris Basin, France.

——— *humilis* Y. LeCalvez, *ibid.*, p. 29, pl. 2, figs. 46–48. Lutetian, Paris Basin, France.

Miliammina sproulei Nauss, Jour. Paleont., vol. 21, p. 339, pl. 48, fig. 13. Upper Cretaceous, Alberta, Canada.

Miliola robusta Y. LeCalvez, Mém. Soc. géol. France, p. 32, pl. 3, figs. 58–60. Lutetian, Paris Basin, France.

Millerella chesterensis Cooper, Jour. Paleont., vol. 21, p. 85, pl. 19, figs. 1–5. Mississippian, Illinois.

——— *kinkaidensis* Cooper, *ibid.*, vol. 21, p. 86, pl. 19, figs. 9, 10. Mississippian, Illinois.

——— *zelleri* Cooper, *ibid.*, vol. 21, p. 86, pl. 19, figs. 6–8. Mississippian, Illinois.

MIOGYPSININAE subfam. nov., Hanzawa, *ibid.*, vol. 21, p. 262. New subfamily of Miogypsinidae Tan Sin Hok, 1936. Includes the genera: *Miogypsina* Sacco, 1893, and *Miolepidocyclina* Silvestri, 1907. (Hanzawa's new subfamily is an emendation of subfam. Miogypsininae Vaughan, 1928.)

MIOGYPSINOIDINAE subfam. nov. Hanzawa, *ibid.*, vol. 21, p. 262. New subfamily of Miogypsinidae Tan Sin Hok, 1936. Includes the genera: *Miogypsinoides* Yabe and Hanzawa, 1928; *Miogypsinella* Hanzawa, 1940; *Miogypsinoides* Hanzawa, 1940; and *Heterosteginoides* Cushman, 1918.

MORULAEPLECTA gen. nov., Höglund. Zool. Bidr. Uppsala, vol. 26, p. 165. Family not stated (Textulariidae). Genotype: *Morulaeplecta bulbosa* Höglund, 1947, *ut infra*. Recent, Atlantic, Sweden.

——— *bulbosa* Höglund, *ibid.*, vol. 26, p. 165, pl. 12, fig. 2; text fig. 142. Recent, Gullmar Fjord, Sweden, 20–50 m.

MULTISPIRINA gen. nov. Reichel, Schweiz. Paläont. Abhandl., vol. 65, p. 2. Family Alveolinidae. Genotype: *Multispirina iranensis* Reichel, 1947, *ut infra*. Upper Cretaceous.

——— *iranensis* Reichel, *ibid.*, vol. 65, p. 2, pl. 1, fig. 1–4; pl. 2, figs. 1–4; pl. 3, figs. 1–7; pl. 4, figs. 1, 2; text figs. 1–5. Cenomanian, Iran.

Nankinella plummeri Thompson, Jour. Paleont., vol. 21, p. 155, pl. 32, figs. 11–16; pl. 33, figs. 10, 11. Pennsylvanian, Texas.

Neoschwagerina iisakai Toriyama, Japan. Jour. Geol. Geogr., vol. 20, p. 81, pl. 17. figs. 12–17. Permian, Japan.

——— *staffelloides* Toriyama, *ibid.*, vol. 20, *ibid.*, vol. 20, p. 80, pl. 17, fig. 11. Permian, Japan.

Nodosaria chirana Cushman and Stone, Cushman Lab. Foram. Res., Spec. Publ. No. 20, p. 6, pl. 1, figs. 18–21. Upper Eocene, NW Peru.

——— *frankei* Payard, Foram. Lias sup. Détroit Poitevin, Thesis Univ. Paris, p. 160, pl. 2, fig. 4. Toarcian, France. For: *Nodosaria crispata* Franke, 1936 (non Terquem).

——— *frizzelli* Cushman and Stone, Cushman Lab. Foram. Res., Spec. Publ. No. 20, p. 7, pl. 1, fig. 30. Eocene, NW Peru.

——— *hexacostata* Payard, Foram. Lias sup. Détroit Poitevin, Thesis Univ. Paris, p. 161, pl. 2, fig. 6. Toarcian, France.

——— *interruptospinata* Payard, *ibid.*, Thesis Univ. Paris, p. 161, pl. 2, fig. 5. Charmouthian, France.

——— *mitis* Terquem & Berthelin, 1875, var. *conica* Payard, *ibid.*, Thesis Univ. Paris, p. 171, pl. 2, fig. 19. Toarcian-Aalenian, France. [Note: The varietal name is preoccupied by *Nodosaria conica* Neugeboren, 1852, Verh. Mitth. Siebenbürg. Ver. Naturwiss., vol. 3, p. 54, pl. 1, fig. 4; and by: *Nodosaria conica*

O. Silvestri, 1872, Atti Accad. Gioenia Sci. Nat. Catania (3), vol. 7, p. 39, pl. 3, figs. 52–57.]

——— *paucicosta* Payard, *ibid.*, Thesis Univ. Paris, p. 169, pl. 2, fig. 16. Toarcian-Aalenian, France. (This species name is preoccupied by: *Nodosaria paucicosta* Römer, 1841. Verst. Norddeutsch. Kreidegeb., p. 95, pl. 15, fig. 7; and by: *Nodosaria subscalaris* Cushman, 1917, var. *paucicosta* Cushman, 1917, Proc. U. S. Nat. Mus., vol. 51, No. 2172, p. 654, figured in: Bull. U. S. Nat. Mus., vol. 100, pt. 4, pl. 36, figs. 3, 4).

——— *sanctae-herminae* Payard, *ibid.*, Thesis Univ. Paris, p. 167, pl. 2, fig. 22. Charmouthian, France.

——— *tenuistriata* Payard, *ibid.*, Thesis Univ. Paris, p. 169, pl. 2, fig. 13. Aalenian, France. (Note: The species name is preoccupied by: *Nodosaria tenuistriata* Franke, 1925, Abhandl. Geol.-Paläont. Inst. Univ. Griefswald, Nr. 6, p. 39, pl. 3, fig. 33; and by: *Nodosaria tenuistriata* Eichenberg, 1935, Jahresber. Niedersächs.-Geol. Ver., vol. 26, p. 172, pl. 11, fig. 13.)

——— *unguis* Payard, *ibid.*, Thesis Univ. Paris, p. 172, pl. 2, fig. 23. Toarcian-Aalenian, France.

Nonion chiranum Cushman and Stone, Cushman, Lab. Foram. Res., Spec. Publ. No. 20, p. 10, pl. 1, fig. 27. Upper Eocene, NW Peru.

——— *sloani* (d'Orbigny, 1839), var. *nitida* Cushman, *ibid.*, Contr., vol. 23, p. 90, pl. 19, fig. 9. Recent, Atlantic, off Florida.

Nonionella atlantica Cushman, *ibid.*, Contr., vol. 23, p. 90, pl. 20, figs. 4, 5. Recent, Atlantic, off Florida, 45 m.

——— *opima* Cushman, *ibid.*, Contr., vol. 23, p. 90, pl. 20, figs. 1–3. Recent, Atlantic, off Florida.

Nummulites boninensis Hanzawa, Jour. Paleont., vol. 21, p. 256, pl. 39, figs. 1–13, pl. 40, figs. 1–9. Lutetian, Bonin-Group of Islands, Pacific.

——— (*Nummulites*) *dorotheae* de Cizancourt, Bull. Soc. géol. France, (5), vol. 17, p. 513, pl. 24, figs. 1–3, 5–7. Eocene, Cuba. (Published September 1948.)

——— (———) *rutteni* de Cizancourt, *ibid.* (5), vol. 17, p. 515, forma A: pl. 25, figs. 2, 3, and 11; forma B: pl. 24, fig. 4; pl. 25, figs. 1, 6, 7, 12. Eocene, Cuba. (Published September 1948.)

Nuttalides carinotrumpyi Finlay, N. Zealand Jour. Sci. Techn., vol. 28 (B), p. 287, pl. 9, figs. 135–142. Paleocene, New Zealand.

——— *cretatrumpyi* Finlay, *ibid.*, vol. 28 (B), p. 287. Only described, not figured. Uppermost Senonian, New Zealand.

Orbignyna pyrei Cushman, Cushman Lab. Foram. Res., Contr., vol. 23, p. 8, pl. 2, figs. 19, 20. Upper Cretaceous, Venezuela.

Palaeotextularia asper (*recte: aspera*) Cooper, Jour. Paleont., vol. 21, p. 89, pl. 20, figs. 31, 32. Mississippian, Illinois.

PARAFISSURINA gen. nov. Parr, Roy. Soc. Victoria, Proc., vol. 58, new series, p. 123. Fam. Lagenidae. Genotype: *Lagena ventricosa* A. Silvestri, 1904, Atti R. Accad. Sci. Torino, vol. 39, p. 11, text fig. 6. Middle Eocene to Recent. (Note: This new genus is proposed "for hooded lagenid forms.")

Pellatispira reticularis Hanzawa, Japan. Jour. Geol. Geogr., vol. 20, p. 59, pl. 14, figs. 1–3; pl. 15, fig. 1. Eocene, New Britain.

Pelosina variabilis Brady, 1879, var. *sphaeriloculum* Höglund, Zool. Bidr. Uppsala, vol. 26, p. 61, pl. 6, figs. 8–11. Recent, Skagerak, Sweden, 515 m.

PFENDERINA gen. nov. Henson, Ann. Mag. Nat. Hist. (11), vol. 14, p. 609. Family: Trochamminidae; subfam.: Tetrataxinae. Genotype: *Eorupertia necocomiensis* Pfender, 1938, Bull. Soc. géol. France (5), vol. 8, p. 236, pl. 16, figs. 1–7. Upper Jurassic to Cenomanian. (Published June 1948.)

Pilulina argentea Höglund, Zool. Bidr. Uppsala, vol. 26, p. 64, pl. 8, figs. 11–14. Recent, Skagerak, Sweden, 700 m.

Placopsilina cremacula Payard, Foram. Lias sup. Détroit Poitevin, Thesis Univ. Paris, p. 78, pl. 1, fig. 10. Toarcian, France.

Planorbulina macphersoni Finlay, New Zealand Jour. Sci. Techn., vol. 28 (B), p. 287, pl. 8, figs. 125–128. Lower Eocene, New Zealand.

Planorbulinella zelandica Finlay, *ibid.*, vol. 28 (B), p. 290, pl. 8, figs. 119–124. Top Middle Miocene, New Zealand.

Planularia deadericki Cushman, Cushman Lab. Foram. Res., Contr., vol. 23, p. 56, pl. 13, figs. 11–13. Upper Cretaceous, Arkansas.

Planulina alaskensis Cushman and Todd, *ibid.*, vol. 23, p. 71, pl. 16, figs. 25, 26. Pliocene ?, Alaska.

——— *astoriensis* Cushman, Stewart and Stewart, Oregon Dept. Geol. etc., Bull. No. 36, p. 23, pl. 4, figs. 4, 5. Miocene, western Oregon. (Published May 28, 1948).

——— *chirana* Cushman and Stone, Cushman Lab. Foram. Res., Spec. Publ. No. 20, p. 26, pl. 4, fig. 3. Upper Eocene, NW Peru.

——— *crenulata* Cushman and Stone, *ibid.*, Spec. Publ. No. 20, p. 26, pl. 4, figs. 4, 5. Upper Eocene, NW Peru.

——— *peruviana* Cushman and Stone, *ibid.*, Spec. Publ. No. 20, p. 26, pl. 4, fig. 6. Upper Eocene, NW Peru.

Plectofrondicularia dentifera Cushman and Stainforth, *ibid.*, Contr., vol. 23, p. 77, pl. 17, figs. 2, 3. Upper Eocene, Ecuador.

——— *oregonensis* Cushman, Stewart and Stewart, Oregon Dept. of Geol. etc., Bull. No. 36, p. 100, pl. 13, figs. 8, 9. Eocene, western Oregon (published May 28, 1948).

——— *peruviana* Cushman and Stone, Cushman Lab. Foram. Res., Spec. Publ. No. 20, p. 11, pl. 2, figs. 1–3. Eocene, NW Peru.

——— *proparri* Finlay, New Zealand Jour. Sci. Techn., vol. 28 (B), p. 276, pl. 4, figs. 46–48. Middle Oligocene, New Zealand.

——— *searsi* Cushman, Stewart and Stewart, Oregon Dept. of Geol. etc., Bull. No. 36, p. 78, pl. 10, fig. 5; pl. 11, fig. 8. Upper Eocene, western Oregon. (Published May 28, 1948).

Pleurostomella paleocenica Cushman, Cushman Lab. Foram. Res., Contr., vol. 23, p. 86, pl. 18, figs. 14, 15. Paleocene, Texas. For: *Pleuro-*

stomella alternans Plummer, 1927, (non Schwager, 1866), Univ. Texas Bull. No. 2644, p. 69, pl. 4, fig. 2; and for: *Pleurostomella cf. brevis* (Schwager 1866) var. *alternans* Kline, 1943, (non Schwager 1866), Mississippi State Geol. Surv., Bull. No. 53, p. 50, pl. 6, fig. 23.

Polymorphina kincaidi Cushman and Todd, *ibid.*, Spec. Publ. No. 21, p. 12, pl. 2, figs. 9, 10. Recent, Friday Harbor, Pacific, Washington).

Profusulinella marblensis Thompson, Jour. Paleont., vol. 21, p. 162, pl. 31, figs. 11, 12; pl. 32, figs. 1–10. Pennsylvanian, Texas.

Proporocyclina see *Pseudophragmina*

Proteonina difflugiformis (Brady, 1879) var. *calcarea* Cushman, Cushman Lab. Foram. Res., Contr., vol. 23, p. 86, pl. 18, fig. 16. Recent, Atlantic, off Florida.

——— *reinholdi nom. nov.* ten Dam, *ibid.*, Contr., vol. 23, p. 73. Lower Cretaceous, Holland. New name for: *Proteonina testacea* ten Dam, 1947, (non Flint, 1899), Geol. en Mijnbouw, vol. 9, p. 25, text fig. 1, *ut infra.*

——— *testacea* ten Dam, Geol. en Mijnbouw, vol. 9, p. 25, text fig. 1. Albian, Holland. (Preoccupied by *Proteonina testacea* (Flint, 1899), and, therefore, renamed by the author: *Proteonina reinholdi nom. nov., ut supra.*)

Psammosiphon remesi Prantl, Vest. Stat. geol. Ust. Csekoslov., vol. 22, No. 4, p. 227, pl. 1, figs. 1, 2. Devonian, Bohemia.

Psammosphaera delicatula Stewart and Lampe, Jour. Paleont., vol. 21, p. 532, pl. 78, fig. 1. Middle Devonian, Ohio.

——— *devonica* Stewart and Lampe, *ibid.*, vol. 21, p. 533, pl. 78, fig. 2. Middle Devonian, Ohio.

——— *discoidea* Stewart and Lampe, *ibid.*, vol. 21, p. 533, pl. 78, fig. 3. Middle Devonian, Ohio.

——— *rotunda* Stewart and Lampe, *ibid.*, vol. 21, p. 533, pl. 78, fig. 4. Middle Devonian, Ohio.

PSEUDOCITHARINA gen. nov. Payard, Foram. Lias sup. Détroit Poitevin, Thesis Univ. Paris, p. 118. Fam. Lagenidae. Genotype: *Marginulina colliezi* Terquem, 1866, Mém. Acad. Impér. Metz. Cinq. Mém., p. 430, pl. 17, fig. 10. Upper Liassic to Middle Cretaceous.

——— *chicheryi* Payard, *ibid.*, Thesis Univ. Paris, p. 128, pl. 3, fig. 1. Toarcian and Aalenian, France.

——— *colliezi* (Terquem, 1866) var. *parallela* Payard, *ibid.*, Thesis Univ. Paris, p. 125, pl. 3, figs. 4, 5. Toarcian-Aalenian, France.

——— *dorsoventrocarinata* Payard, *ibid.*, Thesis Univ. Paris, p. 139, pl. 5, figs. 7, 8. Toarcian, France.

——— *enigmatica* Payard, *ibid.*, Thesis Univ. Paris, p. 141, pl. 5, fig. 6. Toarcian, France.

——— *fallax* Payard, *ibid.*, Thesis Univ. Paris, p. 129, pl. 5, figs. 1–4. Toarcian, France.

——— *fasciata* Payard, *ibid.*, Thesis Univ. Paris, p. 142, pl. 5, figs. 9, 10. Toarcian, France.

——— ——— ——— var. *aalense* Payard, *ibid.*, Thesis Univ. Paris, p. 142, pl. 5, figs. 11, 12. Toarcian Aalenian, France. (Note: The varietal name is preoccupied by *Pseudocitharina longuemari* (Terquem, 1863) var. *aalense* Payard, 1947, *ut infra.*)

——— *gillardi* Payard, *ibid.*, Thesis Univ. Paris, p. 130, pl. 3, figs. 15, 19. Toarcian, France.

——— *gladius* Payard, *ibid.*, Thesis Univ. Paris, p. 126, pl. 3, figs. 14. Toarcian, France.

——— *gradata* Payard, *ibid.*, Thesis Univ. Paris, p. 142. pl. 5, fig. 5. Toarcian, France.

——— *inversa* Payard, *ibid.*, Thesis Univ. Paris, p. 149, pl. 4, fig. 21. Toarcian, France.

——— *longuemari* (Terquem, 1863) var. *aalense* Payard, *ibid.*, Thesis Univ. Paris, p. 136, pl. 4, figs. 12, 13. Aalenian, France. For: *Vaginulina proxima* Bartenstein and Brand, 1937, (non Terquem, 1868), Senckenberg. Naturforsch. Ges., Abhandl., Nr. 439, p. 164, pl. 8, fig. 27-a (non fig. 27-b).

——— ——— (———) var. *cordata* Payard, *ibid.*, Thesis Univ. Paris, p. 137, pl. 4, figs. 9–11. Toarcian-Aalenian, France.

——— *mariei* Payard, *ibid.*, Thesis Univ. Paris, p. 131, pl. 4, figs. 22, 23. Aalenian, France.

——— *proxima* (Terquem, 1867) var. *compressa* Payard, *ibid.*, Thesis Univ. Paris, p. 147, pl. 3, fig. 25. Toarcian, France.

——— ——— (———) var. *conica* Payard, *ibid.*, Thesis Univ. Paris, p. 145, pl. 3, fig. 24. Toarcian, France.

——— ——— (———) var. *cylindrica* Payard, *ibid.*, Thesis Univ. Paris, p. 146, pl. 3, fig. 20. Toarcian, France.

——— ——— (———) var. *dorsocarinata* Payard, *ibid.*, Thesis Univ. Paris, p. 145, pl. 3, fig. 21. Upper Toarcian, France.

——— ——— (———) var. *intercostata* Payard, *ibid.*, Thesis Univ. Paris, p. 147, pl. 3, fig. 23. Toarcian, France.

——— *pseudorecta* Payard, *ibid.*, Thesis Univ. Paris, p. 127, pl. 3, fig. 12. Aalenian, France.

——— *subaequilateralis* (Terquem, 1867) var. *asymetrica* Payard, *ibid.*, Thesis Univ. Paris, p. 141, pl. 4, fig. 20. Toarcian, France.

——— ——— (———) var. *typica* Payard, *ibid.*, Thesis Univ. Paris, p. 140, pl. 4, fig. 18. Toarcian, France.

——— *toarcense* Payard, *ibid.*, Thesis Univ. Paris, p. 149, pl. 3, figs. 16, 17. Toarcian, France.

——— *tricosta* Payard, *ibid.*, Thesis Univ. Paris, p. 131, pl. 3, fig. 18; pl. 7, fig. 13. Aalenian, France.

——— *welchi* Payard, *ibid.*, Thesis Univ. Paris, p. 148, pl. 4, figs. 14, 19. Toarcian, France.

Pseudophragmina (*Proporocyclina*) *habanensis* Cole and Bermudez, Bull. Am. Paleontology, vol. 31, No. 125, p. 19, pl. 6, figs. 5–8. Eocene, Cuba.

Pyrgo eocenica Y. LeCalvez, Mém. Carte géol. France, p. 21, pl. 4, figs. 77–79. Lutetian, Paris Basin, France.

Quinqueloculina brevidentata nom. nov. Y. LeCalvez, Mém. Carte géol. France, p. 16, pl. 1, figs. 25–27. Lutetian, Paris Basin, France. New name for: *Quinqueloculina longidentata* Terquem, 1882, pro parte, Mém. Soc. géol. France (3), vol. 2, p. 176, pl. 19, fig. 2 (non pl. 18, figs. 29, 30, non pl. 19, fig. 1).

——— *compta* Cushman, Cushman Lab. Foram.

Res., Contr., vol. 23, p. 87, pl. 19, fig. 2. Recent, Atlantic, off Florida, 45 m.

——— *grignonensis* Y. LeCalvez, Mém. Carte géol. France, p. 14, pl. 1, figs. 1–3. Lutetian, Paris Basin, France.

——— *hexacostata* Y. LeCalvez, *ibid.*, p. 15, pl. 1, figs. 22–24. Lutetian, Paris Basin, France.

——— *horrida* Cushman, Cushman Lab. Foram. Res., Contr., vol. 23, p. 88, pl. 19, fig. 1. Recent, Atlantic, off South Carolina, 120 m.

——— *lippa* Y. LeCalvez, Mém. Carte géol. France, p. 15, pl. 1, figs. 7–9. Lutetian, Paris Basin, France.

——— *naheolensis* Cushman, Cushman Lab. Foram. Res., Contr., vol. 23, p. 82, pl. 17, fig. 14. Paleocene, Alabama.

——— *plummerae* Cushman and Todd, 1942, var. *flectata* Cushman, *ibid.*, Contr., vol. 23, p. 82, pl. 17, fig. 15. Paleocene, Alabama.

——— *sabulosa* Cushman, *ibid.*, Contr., vol. 23, p. 87, pl. 18, fig. 22. Recent, Atlantic, off South Carolina, 120 m.

——— *sphaera* Nauss, Jour. Paleont., vol. 21, p. 340, pl. 48, fig. 14. Upper Cretaceous, Alberta, Canada.

Recurvoides laevigatum Höglund, Zool. Bidr. Uppsala, vol. 26, p. 150, pl. 11, fig. 6; text figs. 117–119. Recent, Koster Channel, Sweden, 200 m.

——— *trochamminiforme* Höglund, *ibid.*, vol. 26, p. 149, pl. 11, figs. 7, 8; pl. 30, fig. 23; text figs. 120. Recent, Gullmar Fjord, Sweden, 15–506 m.

REMESELLA gen. nov. Vasiček, Vest. Stat. geol. Ust. Ceskoslov., vol. 22, p. 246. Fam. Valvulinidae. Genotype: *Remesella mariae* Vasiček, 1947, *ut infra*. Eocene.

——— *mariae* Vasiček, *ibid.*, vol. 22, p. 246, pl. 2, fig. 14; text fig. 2. Eocene, Czechoslovaquia.

Reophax catella Höglund, Zool. Bidr. Uppsala, vol. 26, p. 97, text figs. 77, 78. Recent, Gullmar Fjord, Sweden, 66–305 m.

——— *catenata* Höglund, *ibid.*, vol. 26, p. 99, text figs. 75, 76. Recent, Gullmar Fjord, Sweden, 50 m.

——— *imitator*, Finlay, N. Zealand Jour. Sci. Tech., vol. 28 (B), p. 260, pl. 1, figs. 5–7. Paleocene, New Zealand.

——— *regularis* Höglund, Zool. Bidr. Uppsala, vol. 26, p. 86, pl. 9, figs. 11, 12; pl. 26, figs. 37–43; pl. 27, figs. 24–27; text fig. 53. Recent, Gullmar Fjord, Sweden, 24 m. For: *Reophax dentaliniformis* Goës, 1894, (non Brady, 1881), K. Svensk. Vet. Akad. Handl., vol. 25, No. 9, p. 25, pl. 6, figs. 172–175.

——— *rostrata* Höglund, *ibid.* vol. 26, p. 87, pl. 9, fig. 8; pl. 26, figs. 44–51; pl. 27, figs. 20–23; text figs. 57–60. Recent, Koster Channel, Sweden, 200 meters. For: *? Reophax nodulosus* Goës, 1894, (non Brady, 1879), K. Svensk. Vet. Akad. Handl., vol. 25, No. 9, p. 26, pl. 6, figs. 188–190.

Reusella spinulosa (Reuss, 1850) var. *atlantica* Cushman, Cushman Lab. Foram. Res., Contr., vol. 23, p. 91, pl. 20, figs. 6, 7. Recent, Atlantic, off Florida.

Rhabdammina scabra Höglund, Zool. Bidr. Uppsala, vol. 26, p. 28, pl. 1, figs. 3, 4. Recent, Skagerak, Sweden, 204 m.

Robertina oceanica Cushman and F. L. Parker, U. S. Geol. Surv., Prof. Pap. 210-D, p. 75, pl. 18, fig. 18. Recent, Pacific, North Cape, New Zealand, 75 fathoms. For: *Bulimina declivis* Brady, 1884, (non Reuss, 1863), Challenger Rept., Zool., vol. 9, p. 404, pl. 50, fig. 9; for: *Bulimina declivis* Sidebottom, 1918, (non Reuss, 1863), Jour. R. Micr. Soc., p. 122, pl. 3, figs. 4–6; and for: *Bulimina declivis* Egger 1893, (non Reuss, 1863), Abh. k. Bayer, Akad. Wiss., class 2, vol. 18, p. 290, pl. 8, figs. 64, 65.

ROBERTINOIDES gen. nov. Höglund, Zool. Bidr. Uppsala, vol. 26, p. 222. Family: Buliminidae. Genotype: *Bulimina normani* Goës, 1894, K. Svensk. Vet. Akad. Handl., vol. 25, No. 9, p. 47, pl. 9, figs. 437, 438. Recent.

——— *pumilum* Höglund, *ibid.*, vol. 26, p. 227, pl. 18, fig. 5, Recent. Skagerak, Sweden, 700 meters.

——— *suecicum* Höglund, *ibid.*, vol. 26, p. 225, pl. 18, fig. 4; pl. 19, fig. 2; text figs. 200–202, 204. Recent, Skagerak, Sweden, 360 meters. For: *Bulimina subteres* Goës, 1894, (non Brady, 1881), K. Svensk, Vet. Akad. Handl., vol. 25, No. 9, p. 46, pl. 9, figs. 448–449.

Robulus chiranus Cushman and Stone, Cushman Lab. Foram. Res., Spec. Publ. No. 20, p. 5, pl. 1, fig. 15. Upper Eocene, NW Peru.

——— *clericii* (Fornasini, 1895) var. *acies* Cushman, and H. H. Renz, *ibid.*, Spec. Publ. No. 22, p. 11, pl. 3, fig. 2. Upper Oligocene, Trinidad, B.W.I.

——— *fissilis* Cushman and Stone, *ibid.*, Spec. Publ. No. 20, p. 4, pl. 1, fig. 11. Upper Eocene, NW Peru.

——— *insuetus* Cushman and Stainforth, *ibid.*, Contr., vol. 23, p. 77, pl. 17, fig. 1. Upper Eocene, Ecuador.

——— *insulsus* Cushman, *ibid.*, Contr., vol. 23, p. 83, pl. 18, figs. 2, 3. Paleocene, Texas. For: *Cristellaria orbicularis* Plummer, 1927, (non d'Orbigny, 1826), Univ. Texas Publ. No. 2644, p. 92, pl. 7, fig. 1.

——— *piluliferus* Cushman, *ibid.*, Contr., vol. 23, p. 83, pl. 18, fig. 4. Paleocene, Texas.

Robulus, see also *Cristellaria*

Rotalia bartoniana nom. nov. ten Dam, Jour. Paleont., vol. 21, p. 186. Bartonian, Holland. New name for: *Rotalia granulosa* ten Dam, 1944 (non Karrer, 1865), Medeel. Geol. Sticht. Haarlem (C), vol. V, No. 3, p. 121, pl. 4, fig. 2.

——— *capdevilensis* Cushman and Bermudez, Cushman Lab. Foram. Res., Contr., vol. 23, p. 25, pl. 6, figs. 1–3. Lower Eocene, Cuba.

——— *guantanamensis* Cushman and Bermudez, *ibid.*, Contr., vol. 23, p. 28, pl. 9, figs. 1, 2. Lower Oligocene, Cuba.

——— *havanensis* Cushman and Bermudez, *ibid.*, Contr., vol. 23, p. 24, pl. 5, fig. 5. Paleocene, Cuba.

——— *jabacoensis* Cushman and Bermudez,

ibid., Contr., vol. 23, p. 29, pl. 10, figs. 1–3. Upper Eocene, Cuba.

——— *madrugaensis* Cushman and Bermudez, *ibid.*, Contr., vol. 23, p. 24, pl. 5, fig. 4. Paleocene, Cuba.

——— *orientalis* Cushman and Bermudez, *ibid.*, Contr., vol. 23, p. 26, pl. 7, fig. 2. Upper Eocene, Cuba.

——— *peñonensis* Cushman and Bermudez,, *ibid.*, Contr., vol. 23, p. 25, pl. 6, fig. 4. Middle Eocene, Cuba.

——— *tinarensis* Cushman and Bermudez, *ibid.*, Contr., vol. 23, p. 28, pl. 9, fig. 3. Lower Oligocene, Cuba.

——— *primitiva* Cushman and Bermudez, *ibid.*, Contr., vol. 23, p. 23, pl. 5, figs. 1–3. Upper Cretaceous, Cuba.

Rotalia (?) palmerae Cushman and Bermudez, *ibid.*, Contr., vol. 23, p. 26, pl. 6, Middle Eocene, Cuba.

Saccammina rhumbleri (Franke, 1925) var. *trinitatensis* Cushman and H. H. Renz, Cushman Lab. Foram. Res., Contr., vol. 23, p. 34, pl. 11, fig. 2. Upper Cretaceous, Trinidad, B.W.I.

Schackoina cenomana (Schacko, 1896), subsp. *bicornis* Reichel, Eclog. geol. Helv., vol. 40, No. 2 (published May 31, 1948), p. 401, fig. 6, No. 4; text figs. 4a–g; text fig. 7, No. 4; text fig. 8-b; text fig. 9; text fig. 10, Nos. 5–9, 15. Cenomanian, Southern Switzerland.

——— *gandolfii* Reichel, *ibid.*, vol. 40, No. 2, (published May 31, 1948), p. 397, text fig. 6, No. 3; text fig. 7, No. 3; text fig. 8-a; text fig. 10; Nos. 1, 3, 4, 11; pl. 8. Cenomanian, Southern Switzerland.

——— *jeanneti* Reichel, *ibid.*, vol. 40, No. 2, (published May 31, 1948), p. 404, pl. 8, fig. 8; text fig. 10, No. 16; Lower Turonian, Switzerland.

——— *moliniensis* Reichel, *ibid.*, vol. 40, No. 2, (published May 31, 1948), p. 402, text fig. 5; text fig. 6, No. 5; text fig. 7, No. 5-a; text fig. 5 b–d; text fig. 8-c; text fig. 10, No. 13. Cenomanian, Southern Switzerland.

——— *pentagonalis* Reichel, *ibid.*, vol. 40, No. 2, (published May 31, 1948), p. 395, text fig. 1; text fig. 6; text fig. 7, No. 1; Upper Albian or lower Cenomanian, Southern Switzerland.

——— ——— ——— var. *aperta* Reichel, *ibid.*, vol. 40, No. 2, p. 397, text fig. 6, Nos. 2 a–d. Top Albian or basal Cenomanian, Southern Switzerland.

Schenckiella alabamensis nom. nov. Cushman, Cushman Lab. Foram. Res., Spec. Publ. No. 8-A, p. 51, pl. 8, fig. 10. Paleocene. Alabama. New name for: *Listerella laevis* Cushman, 1940 (non Finlay, 1939), Contr. Cushman Lab. Foram. Res., vol. 16, p. 54, pl. 9, fig. 8.

Semivulvulina ihungia Finlay, N. Zealand Jour. Sci. Techn., vol. 28 (B), p. 264. Described, but not figured. Lower Miocene, New Zealand.

——— *prisca* Finlay, *ibid.*, vol. 28 (B), p. 264, pl. 2, figs. 24–26. Middle Eocene, New Zealand.

Sigmoilina cushmani nom. nov. Finlay, *ibid.*, vol. 28 (B), p. 271. Upper Eocene to Middle Miocene. New name proposed for *Sigmoilina sigmoidea* (Brady) var. *compressa* Cushman, 1946 (non *Sigmoilina tchokrakensis* Gherke, 1938, var. *compressa* Gherke, 1938). Finlay's new name, however, is invalid, because Cushman has changed his homonym already to: *Sigmoilina victoriensis* Cushman, 1946, Contr. Cushman Lab. Foram. Res., vol. 22, p. 103. Finlay's species becomes, thus, a synonym of *S. victoriensis* Cushman, 1946.

——— *trinitatensis* Cushman and H. H. Renz, Cushman Lab. Foram. Res., Spec. Publ. No. 20, p. 10, pl. 2, figs. 21, 22. Upper Oligocene, Trinidad, B.W.I.

SIGMOILOPSIS gen. nov. Finlay, N. Zealand Jour. Sci. Techn., vol. 28 (B), p. 270. Family: Miliolidae. Genotype: *Sigmoilina schlumbergeri* Silvestri, "as interpreted and figured by Cushman, 1946, Contr. Cushman Lab. Foram. Res., vol. 22, p. 36, pl. 6, figs. 1–4, and by H. B. Brady, 1884, Challenger Rept. Zool., vol. 9, pl. 8, figs. 1, 2 and 4 (non fig. 3)." Oligocene to ? Recent.

Sorosphaera bicelloidea Stewart and Lampe, Jour. Paleont., vol. 21, p. 534, p. 78, fig. 6. Middle Devonian, Ohio.

——— *columbiense* (*recte: columbiensis*) Stewart and Lampe, *ibid.*, vol. 21, p. 533, pl. 78, fig. 5. Middle Devonian, Ohio.

SOROSPHAEROIDEA gen. nov. Stewart and Lampe, *ibid.*, vol. 21, p. 534. Family: Saccamminidae; subfam.: Pseudosphaerinae. Genotype: *Sorosphaeroidea polygonia* Stewart and Lampe, 1947, *ut infra*. Middle Devonian.

——— *polygonia* Stewart and Lampe, *ibid.*, vol. 21, p. 534, pl. 78, fig. 7. Middle Devonian, Ohio.

Spiroloculina atlantica Cushman, Cushman Lab. Foram. Res., Contr., vol. 23, p. 88, pl. 19, figs. 3–5. Recent, Atlantic, off Florida, 27 m. For: *Spiroloculina planulata* Cushman, 1929, pro parte (non Lamarck, 1804), U. S. Nat. Mus. Bull. 104, pt. 6, p. 41, pl. 8, fig. 2 (non figs. 3–5).

——— *carinata nom. nov.* Y. LeCalvez, Mém. Carte géol. France, p. 26, pl. 2, figs. 32, 33. Lutetian, Paris Basin. [Note: LeCalvez proposes this new name for: *Spiroculina ornata* Terquem, 1882, Mém. Soc. géol. France (3), vol. 2, p. 159, pl. 16, fig. 23, but Terquem's species has already been renamed: *Sp. terquemiana* Heron-Allen and Earland, 1911, Jour. R. Micr. Soc., p. 302 on account of homonymy with d'Orbigny, 1839. LeCalvez also cites *Spiroloculina striata* Terquem, 1882, *loc. cit.*, p. 160, pl. 16, fig. 26, which species, however, has been placed into synonymy with *Sp. costigera* Terquem, 1882, according to Cushman and Todd, 1944, Spec. Publ. No. 11, Cushman Lab. Foram. Res., p. 11.]

——— *contorta* Y. LeCalvez, *ibid.*, p. 29, pl. 2, figs. 38, 39. Lutetian, Paris Basin, France.

——— *parisiensis nom. nov.* Y. LeCalvez, *ibid.*, p. 28, pl. 2, figs. 42, 43. Lutetian, Paris Basin, France. New name for: *Triloculina tricosta* Terquem, 1882. Mém. Soc. géol. France (3), vol. 2, p. 166, pl. 17, figs. 7, 8, 11.

——— *ubiqua nom. nov.* Y. LeCalvez, *ibid.*, p.

27, pl. 2, figs. 40, 41. Lutetian, Paris Basin, France. New name for: *Spiroloculina angulifera* Terquem, 1882, pro parte, Mém. Soc. géol. France (3), vol. 2, p. 156, pl. 16, fig. 13 (non figs. 9–12, 14, 15). (Note: Terquem's species is regarded by Cushman and Todd, 1944, Spec. Publ. No. 11, Cushman Lab. Foram. Res., p. 74, as belonging probably to the genus *Spirophthalmidium*).

Spiroplectammina paleocenica Cushman, Cushman Lab. Foram. Res., Contr., vol. 23, p. 81, pl. 17, fig. 17. Paleocene, Alabama.

——— *rectangularis* ten Dam, Geol. en Mijnbouw, vol. 9, p. 25, text fig. 2. Albian, Holland.

Staffella expansa Thompson, Jour. Paleont., vol. 21, p. 157, pl. 31, fig. 19; pl. 33, figs. 1–4. Pennsylvanian, Texas.

Stilostomella jaculator Finlay, New Zealand, Jour. Sci. Techn., vol. 28 (B), p. 275, pl. 4, figs. 43–45. Middle Miocene, New Zealand.

STILOSTOMELLINAE subfam. nov., Finlay, *ibid.*, vol. 28 (B), p. 275. Includes the genera: *Stilostomella* Guppy, 1894; *Lagenonodosaria* Silvestri, 1900, and *Chrysalogonium* Schubert, 1907. Upper Cretaceous to Recent.

Technitella atlantica Cushman, Cushman Lab. Foram. Res., Contr., vol. 23, p. 87, pl. 18, fig. 17. Recent, Atlantic, off Florida.

Textularia bocki Höglund, Zool. Bidr. Uppsala, vol. 26, p. 171, pl. 12, figs. 5–7; text figs. 152, 153. Recent, Malmö Fjord, Sweden, 20–305 m. For: *Textularia agglutinans* Goës, 1894 (non d'Orbigny, 1846), K. Svensk. Vet. Akad. Handl., vol. 25, No. 9, p. 35, pl. 7, figs. 281–284, 294–296.

——— *contorta* Höglund, *ibid.*, vol. 26, p. 182, pl. 13, fig. 4; text fig. 158. Recent, Gullmar Fjord, Sweden, 39–67 m.

——— *descrescens* Cushman and ten Dam, Cushman Lab. Foram. Res., Contr., vol. 23, p. 58, pl. 14, fig. 5. Lower Pliocene, Holland.

——— *eyrei* Finlay, New Zealand Jour. Sci. Tech., vol. 26 (B), p. 266, pl. 1, figs. 13–17. Lower Eocene, New Zealand.

——— *gladizea* Finlay, *ibid.*, vol. 28 (B), p. 267, pl. 3, figs. 27, 28. Middle Miocene, New Zealand.

——— *gracillima* Höglund, Zool. Bidr. Uppsala, vol. 26, p. 180, pl. 13, fig. 2; text fig. 156. Recent, Kattegat, Sweden, 20–305 m. (Note: Since this species name is preoccupied by Andreae, 1884, Abh. geol. Spec.-Karte Elsass-Lothr., vol. 2, Heft. 3, p. 235, pl. 8, fig. 9, Höglund subsequently changed his homonym to *Textularia kattagatensis* Höglund *nom. nov.*, Contr. Cushman Lab. Foram. Res., vol. 24, p. 46, 1948.)

——— *kapitea* Finlay, New Zealand Jour. Sci. Techn., vol. 28 (B), p. 266, pl. 2, figs. 21, 22. Upper Miocene, New Zealand.

——— *plummerae* Lalicker, 1935, var. *arkansana* Cushman, Cushman Lab. Foram. Res., Contr., vol. 23, p. 81, pl. 17, figs. 18, 19. Paleocene, Arkansas. For: *Textularia plummerae* Lalicker var. in: Cushman and Todd, 1946. Contr. Cushman Lab. Foram. Res., vol. 22, p. 46, pl. 7, fig. 2.

——— *portenta* Cushman, *ibid.*, Contr., vol. 23, p. 81, pl. 17, fig. 16. Paleocene, Arkansas.

——— *pseudomiozea* Finlay, N. Zealand Jour. Sci. Techn., vol. 28 (B), p. 266, pl. 2, fig. 23. Middle Oligocene, New Zealand.

——— *sculpturata* Cushman and ten Dam, Cushman Lab. Foram. Res., Contr., vol. 23, p. 58, pl. 14, fig. 4. Lower Pliocene, Holland.

——— *skagerakensis* Höglund, Zool. Bidr. Uppsala, vol. 26, p. 183, pl. 13, fig. 3; text fig. 157. Recent, Skagerak, Sweden, 199–626 m.

——— *truncata* Höglund, *ibid.*, vol. 26, p. 175, pl. 12, figs. 8, 9; text figs. 147–149. Recent, Sweden, 30–40 fathoms.

Tholosina ? circularis Stewart and Lampe, Jour. Paleont., vol. 21, p. 536, pl. 79, fig. 4. Middle Devonian, Ohio.

——— *? ovoidea* Stewart and Lampe, *ibid.*, vol. 21, p. 536, pl. 79, fig. 5. Middle Devonian, Ohio.

Thurammina pattei Payard, Foram. Lias sup. Détroit Poitevin, Thesis Univ. Paris, p. 54, pl. 1, fig. 1. Upper Liassic, France.

——— (*?*) *sphaerica* Höglund, Zool. Bidr. Uppsala, vol. 26, p. 54, pl. 4, figs. 22–26. Recent, Sweden, Gullmar Fjord, 7 meters. [Note: Since this species name is preoccupied by Ireland, 1939, Jour. Paleont., vol. 13, p. 197, text figs. A-33 and A-34, Höglund subsequently changed his homonym to: *Thurammina (?) faerleensis* Höglund, *nom. nov.*, 1948, Contr. Cushman Lab. Foram. Res., vol. 24, p. 45.]

Trepeilopsis mississippiana Cooper, Jour. Paleont., vol. 23, p. 87, pl. 20, figs. 34–41. Mississippian, Illinois.

Triloculina crenulata Y. LeCalvez, Mém. Carte géol. France, p. 19, pl. 4, figs. 67, 68. Lutetian, Paris Basin, France.

——— *frederica* Y. LeCalvez, *ibid.*, p. 20, pl. 4, figs. 69–71. Lutetian, Paris Basin, France.

——— *pseudo-hemisphaerica* Y. LeCalvez, *ibid.*, p. 19, pl. 4, figs. 75, 76. Lutetian, Paris Basin, France.

Trochammina globigeriniformis Parker and Jones, 1865, var. *pygmaea* Höglund, Zool. Bidr. Uppsala, vol. 26, p. 2000, pl. 17, fig. 3; text fig. 182. Recent, Skagerak, Sweden, 400–507 m.

——— *labiosa* Höglund, *ibid.*, vol. 26, p. 207, pl. 15, fig. 6; text fig. 189. Recent, Skagerak, Sweden, 50–199 m.

——— *multiloculata* Höglund, *ibid.*, vol. 26, p. 211, pl. 15, fig. 5; text fig. 193. Recent, Skagerak, Sweden, 196–201 m.

——— *parallela* Cushman and Applin, Cushman Lab. Foram. Res., Contr., vol. 23, p. 54, pl. 13, figs. 5. Upper Cretaceous, Texas.

——— *pusilla* Höglund, Zool. Bidr. Uppsala, vol. 26, p. 201, pl. 17, fig. 4; text figs. 183, 184. Recent, off Sweden, 200 m. (Note: The species name is preoccupied by Geinitz, 1848, and, therefore, Höglund changed his homonym subsequently to: *Trochammina quadriloba* Höglund, *nom. nov.* 1948, Contr. Cushman Lab. Foram. Res., vol. 24, p. 46.

——— *stellata* Höglund, *ibid.*, vol. 26, p. 210, pl. 15, figs. 3, 4; text fig. 187. Recent, Kattegat, Sweden, 40–200 m.

Trochamminella bullata Höglund, *ibid.*, vol. 26, p. 213, pl. 17, fig. 5; text figs. 194, 195.

Trocholina altispira Henson, Ann. Mag. Nat. Hist. (11), vol. 14, p. 455, pl. 11, fig. 3; pl. 13, fig. 8 (published April 1948). Lower Cenomanian, Arabia.

——— *floridana* Cushman and Applin, Cushman Lab. Foram. Res., Contr., vol. 23, p. 29, pl. 10, figs. 6–10. Lower Cretaceous, Florida.

——— *intermedia* Henson, Ann. Mag. Nat. Hist. (11), vol. 14, p. 454, pl. 11, fig. 2; pl. 12, fig. 10 (published April 1948). Lower Cenomanian, Arabia. (Note: The species name is preoccupied by Frentzen, 1941, Beitr. naturkund. Forschg. Oberrheingebiet, vol. 6, p. 305, pl. 1, fig. 10.)

——— *lenticularis* Henson, *ibid.*, vol. 14, p. 452, pl. 11, fig. 1; pl. 12, figs. 1–3, 5–8 (published April 1948). Lower Cenomanian, Arabia.

——— ——— ——— var. *minima* Henson, *ibid.*, vol. 14, p. 453, pl. 11, fig. 5; pl. 12, fig. 4 (published April 1948). Upper Cenomanian, Arabia.

——— *palastiniensis* Henson, *ibid.*, vol. 14, p. 450, pl. 11, fig. 4; pl. 13, figs. 5–7, 9, 10 (published April 1948). Jurassic, Southern Palestine.

Uvigerina chirana Cushman and Stone, Cushman Lab. Foram. Res., Spec., Publ. No. 20, p. 17, pl. 2, fig. 25. Upper Eocene, NW Peru.

——— *cushmani* Todd (MS) *in:* Cushman and Todd, *ibid.*, Contr., vol. 23, p. 66, pl. 16, figs. 4, 5. Pliocene ?, Alaska. (Note: The same species has also been published as a new species in Cushman and McCulloch, 1948, Allen Hancock Pacific Exped., vol. 6, No. 5, p. 257, pl. 31, fig. 1, from the Pacific, off California.)

——— *peruviana* Cushman and Stone, *ibid.*, Spec. Publ. No. 20, p. 18, pl. 2, fig. 24. Eocene, NW Peru.

Vaginulina obtusicosta nom. nov. ten Dam and Reinhold, Jour. Paleont., vol. 21, p. 186. Middle Miocene, Holland. New name for *Vaginulina striatula* ten Dam and Reinhold, 1942 (non Roemer, 1842), Mededeel, Geol. Sticht. Haarlem (C), vol. V, No. 2, p. 65, pl. 4, fig. 10; pl. 9, fig. 12.

Vaginulinopsis marwicki Finlay, New Zealand Jour. Sci. Techn., vol. 28 (B), p. 272, pl. 9, figs. 150–152. Middle Eocene, New Zealand.

Valvulammina picardi Henson, Ann. Mag. Nat. Hist. (11), vol. 14, p. 613, pl. 18, figs. 3–6; pl. 15, figs. 1, 3 (published June 1948.) Santonian, Egypt.

Valvulina kitchini Henson, *ibid.*, vol. 14, p. 612, pl. 18, figs. 4–7. (Published June 1948.) Upper Eocene, SW Iraq.

Valvulinella jurassica Henson, *ibid.*, vol. 14, p. 607, pl. 16, figs. 1–4, 10; pl. 18, figs. 8, 9. Jurassic, Palestine (published June 1948).

——— *wellingsi* Henson, *ibid.*, vol. 14, p. 606, pl. 15, fig. 9; pl. 16, fig. 5; pl. 18, fig. 1. Jurassic, Palestine (published June 1948).

Valvulineria chirana Cushman and Stone, Cushman Lab. Foram. Res., Spec. Publ. No. 20, p. 22, pl. 3, fig. 3. Upper Eocene, NW Peru.

——— *gracillima nom. nov.* ten Dam, Geol. en Mijnbouw, vol. 9, p. 27, text fig. 4. Albian, Holland New name for: *Placentula nitida* Berthelin, 1880 (non Reuss, 1844), Mém. Soc. géol. France (3), vol. 1, p. 69, pl. 4, fig. 11; and for: *Rotalia soldanii* (d'Orbigny, 1826) var. *nitida* Chapman, 1898 (non Reuss, 1844), Jour. R. Micr. Soc. London (2), vol. 18, p. 2, pl. 1, fig. 2. (Note: Reference is made to the same *nom nov.* erected by ten Dam, 1944, based on the same forms described and figured by Berthelin, 1880, and Chapman, 1898. The year 1944 is, therefore, chosen for *V. gracillima* ten Dam *nom. nov.*)

——— *lobata* Cushman and Applin, Cushman Lab. Foram. Res., Contr., vol. 23, p. 55, pl. 13, fig. 6. Upper Cretaceous, Mississippi. (Note: The species name is preoccupied by *Valvulineria inaequalis* (d'Orbigny, 1839) var. *lobata* Cushman and H. H. Renz, 1941, Contr. Cushman Lab. Foram. Res., vol. 17, p. 23, pl. 3, fig. 24.)

——— *peruviana* Cushman and Stone, *ibid.*, Spec. Publ. No. 20, p. 19, pl. 3, fig. 2. Upper Eocene, NW Peru.

Verbeekina katoi Toriyama, Japan. Jour. Geol. Geogr., vol. 20, p. 69, pl. 16, figs. 5–7. Permian, Japan.

"Verneuilina" cummingensis Nauss, Jour. Paleont., vol. 21, p. 341, pl. 49, fig. 4. Upper Cretaceous, Alberta, Canada.

Verneuilina media Höglund, Zool. Bidr. Uppsala, vol. 26, p. 184, pl. 13, figs. 7–10; pl. 30, fig. 21. Recent, Gullmar Fjord, Sweden, 22–254 meters.

Virgulina concava Höglund, *ibid.*, vol. 26, p. 257, pl. 23, figs. 3, 4; pl. 32, figs. 4–7; text figs. 273–275. Recent, Gullmar Fjord, Sweden, 20–199 meters. For: *Virgulina schreibersiana* Goës. 1894, pro parte (non Czjzek, 1848), K. Svensk Vet. Akad. Handl., vol. 25, No. 9, p. 48, text figs. 461, 465–470.

——— *skagerakensis* Höglund, *ibid.*, vol. 26, p. 255, pl. 23, figs. 1, 2; pl. 32, figs. 1–3; text fig. 272. Recent, Skagerak, Sweden, 215–220 meters.

Vulvulina bortonica Finlay, New Zealand Jour. Sci. Techn., vol. 28 (B), p. 263, pl. 3, figs. 30–32. Middle Eocene, New Zealand.

——— *chirana* Cushman and Stone, Cushman Lab. Foram. Res., Spec. Publ. No. 20, p. 4, pl. 1, fig. 10. Upper Eocene, NW Peru.

——— *espinosa* Finlay, New Zealand Jour. Sci Techn., vol 28 (B), p. 262. Only described, not figured. Eocene, New Zealand.

——— *granulosa* Finlay, *ibid.*, vol. 28 (B), p. 263, pl. 3, figs. 33, 34. Lower Oligocene, New Zealand.

——— *stainforthi* Cushman and H. H. Renz, Cushman Lab. Foram. Res., Spec. Publ. 22, p. 6, pl. 1, fig. 14. Upper Oligocene, Trinidad, B.W.I. For: *Vulvulina spinosa* Cushman and Stainforth, 1945 (non Cushman, 1927), Cushman Lab. Foram. Res., Spec. Publ. 14, p. 15, pl. 1, fig. 18.

——— *zespinosa* Finlay, New Zealand Jour. Sci. Techn., vol. 27 (B), p. 262, pl. 3, figs. 35–37. Paleocene, New Zealand.

WEBBINELLOIDEA gen. nov. Stewart and Lampe, Jour. Paleont., vol. 21, p. 534. Family: Saccamminidae; subfamily: Webbinellinae. Genotype: *Webbinelloidea similis* Stewart and Lampe, 1947, *ut infra*, Middle Devonian.
——— *hemisphaerica* Stewart and Lampe, *ibid.*, vol. 21, p. 535, pl. 79, fig. 1. Middle Devonian, Ohio.
——— *similis* Stewart and Lampe, *ibid.*, vol. 21, p. 535, pl. 78, fig. 8. Middle Devonian, Ohio.
——— *sola* Stewart and Lampe, *ibid.*, vol. 21, p. 535, pl. 79, fig. 2. Middle Devonian, Ohio.
——— *trilocularis* Stewart and Lampe, *ibid.*, vol. 21, p. 535, pl. 79, fig. 3. Middle Devonian, Ohio.
WELLMANELLA gen. nov. Finlay, New Zealand Jour. Sci. Techn., vol. 28 (B), p. 270. Family: Miliolidae. Genotype: *Wellmanella kaiata* Finlay, 1947, *ut infra*. Upper Eocene.
——— *kaiata* Finlay, *ibid.*, vol. 28 (B), p. 270, pl. 9, figs. 146–149. Upper Eocene, New Zealand.

Zeauvigerina teuria Finlay, *ibid.*, vol. 28 (B), p. 276, pl. 4, figs. 49–58. Upper Senonian, New Zealand.

FORMS WITH NOMENCLATURA APERTA

(The numbers in **bold-face** type refer to the publications of the preceding Bibliography for 1947.)

Ammobaculites sp. Cushman, **38,** p. 4, pl. 1, fig. 9, Upper Cretaceous, Venezuela.
Ammodiscus sp. Payard, **174,** p. 56, pl. 1, fig. 21. Upper Liassic, France.
Anomalina sp. Cushman, **38,** p. 18, pl. 4, fig. 30. Upper Cretaceous, Venezuela.
Bolivina (?) sp. Höglund, **129,** p. 275, pl. 24, fig. 3; text fig. 282, Recent, Sweden.
Buliminella sp. Cushman and Renz, **52 a,** p. 23, pl. 6, fig. 1. Upper Oligocene, Trinidad.
Carpenteria sp. Cushman and Renz, **52 a,** p. 46, pl. 8, fig. 17. Upper Oligocene, Trinidad.
Coskinolina sp. Hanzawa, **114,** p. 4, pl. 3, fig. 1. Eocene, New Guinea.
Dentalina sp. Cushman and Renz, **52 a,** p. 15, pl. 4, fig. 16. Upper Oligocene, Trinidad.
——— *(?) sp.* Cushman, Stewart and Stewart, **56,** p. 60, pl. 7, fig. 4. Upper Eocene, Oregon.
Discocyclina sp. Rutten, **197,** p. 45, pl. 4; fig. 21, 22, Eocene, East Borneo.
——— *(Discocyclina ?) sp.* Cole and Bermudez, **32,** p. 15, pl. 7, figs. 1, 8. Eocene, Cuba.
Doliolina sp. (?), Toriyama, **234,** p. 73, pl. 16, fig. 14. Permian, Japan.
Ellipsonodosaria sp. Cushman, Stewart and Stewart, **57,** p. 79, pl. 11, fig. 5. Upper Eocene, Oregon.
——— *sp.* Cushman, Stewart and Stewart, **58,** p. 102, pl. 12, figs. 8, 9. Eocene, Oregon.
——— *sp. A,* Cushman and Stone, **60,** p. 19, pl. 2, fig. 29. Eocene, Peru.
——— *sp. B,* Cushman and Stone, **60,** p. 19, pl. 2, fig. 30. Eocene, Peru.
Entosolenia sp. Cushman and Renz, **52 a,** p. 25, pl. 6, fig. 4. Upper Oligocene, Trinidad.
Eoschubertella spp. Thompson, **231,** p. 162, pl. 31, figs. 13–18. Pennsylvanian, Texas.
Fasciolites sp. a Rutten, **197,** p. 44, pl. 4, fig. 19. Eocene, Borneo.
Frondicularia sp. Cushman, **38,** p. 13, pl. 4, fig. 4. Upper Cretaceous, Venezuela.
Gaudryina sp. A, Cushman, Stewart and Stewart, **57,** p. 74, pl. 11, fig. 1. Upper Eocene, Oregon.
——— *sp. B,* Cushman, Stewart and Stewart, **57,** p. 74, pl. 11, fig. 2. Upper Eocene, Oregon.
Globobulimina species a Höglund, **129,** p. 244, pl. 20, fig. 4; pl. 21, figs. 1, 6; pl. 22, fig. 2; text figs. 234–237. Recent. Caribbean Sea, 463 fathoms.
——— ——— *b* Höglund, **129,** p. 245, pl. 21, figs. 2, 7; pl. 22, fig. 3; text figs. 238–242; Recent, Pacific, 695–1832 fathoms.
——— ——— *c* Höglund, **129,** p. 247, pl. 21, fig. 3; pl. 22, fig. 4; text figs. 243–246. Recent, Gulf of Mexico, 210–978 fathoms.
Globorotalia sp. Cushman, **38,** p. 17, pl. 4, fig. 29, Upper Cretaceous, Venezuela.
Gümbelina sp. Alimen, **3,** p. 447, text fig. 1-C. Oligocene, France.
Guttulina sp. Cushman and Todd, **62,** p. 63, pl. 15, fig. 13. Pliocene ?, Alaska.
Gyroidina sp. Cushman, Stewart and Stewart, **56,** p. 62, pl. 8, fig. 11. Upper Eocene, Oregon.
Hyperammina sp. Cooper, **36,** p. 89, pl. 20, figs. 28, 29. Mississippian, Illinois.
Karreriella sp. Cushman and Todd, **62,** p. 61, pl. 14, figs. 8, 9, Pliocene ?, Alaska.
Lagena sp. A, Cushman and Todd, **62,** p. 63, pl. 15, fig. 10. Pliocene ?, Alaska.
——— *sp. B,* Cushman and Todd, **62,** p. 63, pl. 15, fig. 11. Pliocene ?, Alaska.
Lituonella sp. Cole and Bermudez, **32,** p. 6, pl. 1, fig. 4. Eocene, Cuba.
Marginulina sp. Cushman, **38,** p. 11, pl. 3, fig. 9. Upper Cretaceous, Venezuela.
——— *sp. A,* Cushman and Renz, **52 a,** p. 14, pl. 4, fig. 9. Upper Oligocene, Trinidad.
——— *sp. B,* Cushman and Renz, **52 a,** p. 14, pl. 4, fig. 10. Upper Oligocene, Trinidad.
Millerella sp. Cooper, **36,** p. 82, pl. 19, figs. 10, 12. Mississippian, Illinois.
Nodogenerina sp. Cushman, Stewart and Stewart, **54,** p. 17, pl. 2, figs. 9, 10. Miocene, Oregon.
Nonion sp. Cushman, Stewart and Stewart, **56,** p. 60, pl. 7, fig. 8. Upper Eocene, Oregon.
Pfenderina sp. Henson, **125,** p. 610, pl. 16, figs. 6, 7, 9. Cenomanian, Syria. Upper Jurassic, Iraq.
Plectofrondicularia sp. Cushman, Stewart and Stewart, **54,** p. 16, pl. 2, fig. 4. Miocene, Oregon.
Pleurostomella sp. Cushman and Renz, **52 a,** p. 32, pl. 7, fig. 8. Upper Oligocene, Trinidad.
Polytaxis sp. Payard, **174,** p. 61, pl. 1, fig. 4. Upper Liassic, France.
Pseudocyclammina sp. (bemmeleni Silvestri ?) Hanzawa, **115,** pl. 4, fig. 3. Upper Jurassic, Sumatra.
Pseudoschwagerina sp. Toriyama, **234,** p. 69, pl. 16, figs. 3, 4. Permian, Japan.
Pyrgo sp. Cushman, Stewart and Stewart, **55,** p. 43, pl. 5, fig. 2. Miocene, Oregon.
Quinqueloculina sp. Bursch, **24,** p. 14, pl. 1, figs.

9, 10, 13, 14. Upper Eocene to Lower Oligocene, Great Kei, Indonesia.

——— *sp.* Cushman and Todd, **62,** p. 62, pl. 15, pl. 15, figs. 1, 2. Pliocene ?, Alaska.

Reophax sp. I Höglund, **129,** p. 91, pl. 9, figs. 507. Recent, Sweden.

——— *sp. II* Höglund, **129,** p. 91, pl. 9, fig. 14; text figs. 55, 56. Recent, Sweden.

Robulus sp. Cushman, Stewart and Stewart, **54,** p. 13, pl. 1, fig. 4. Miocene, Oregon.

——— *sp.* Cushman, Stewart and Stewart, **55,** p. 44, pl. 5, fig. 4. Miocene, Oregon.

——— *sp. A* Cushman and Renz, **52 a,** p. 13, pl. 3, fig. 10. Upper Oligocene, Trinidad.

Saracenaria sp. Cushman, Stewart and Stewart, **54,** p. 14, pl. 1, fig. 6. Miocene, Oregon.

Schackoina sp. Reichel, **185,** text fig. 1), Nos. 7, 9, 14; pl. 8, figs. 2–6. Cenomanian, Switzerland.

Sigmoidella sp. Cushman and Stone, **60,** p. 10, pl. 1, fig. 26. Eocene, Peru.

Siphogenerinoides sp. Cushman, **38,** p. 14, pl. 4, fig. 15. Upper Cretaceous, Venezuela.

Sorites sp. Cushman and Renz, **52 a,** p. 22, pl. 5, fig. 17. Upper Oligocene, Trinidad.

Sorites ? sp, Bursch, **24,** p. 24, pl. 1, fig. 27; pl. 3, fig. 14. Aquitanian, Indonesia.

Spiroloculina sp. Cushman and Renz, **52 a,** p. 10, pl. 2, fig. 17. Upper Oligocene, Trinidad.

Staffella sp. Thompson, **231,** p. 159, pl. 33, figs. 5–9. Pennsylvanian, Texas.

——— *sp.* Toriyama, **234,** p. 67, pl. 16, fig. 1. Permian, Japan.

Trochammina sp. Payard, **174,** p. 60, pl. 1, fig. 3. Upper Liassic, France.

Trocholina sp. 1 Henson, **124,** p. 456, pl. 13, figs. 1–4. Juro-Cretaceous, Iraq.

——— *sp. 2* Henson, **124,** p. 457, pl. 2, fig. 11. Permo-Triassic, Iraq.

Valvulineria sp. Cushman and Renz, **52 a,** p. 35, pl. 7, fig. 14. Upper Oligocene, Trinidad.

Verbeekina sp. indet. Toriyama, **234,** p. 70, pl. 16, fig. 8. Permian, Japan.

NOMINA NUDA

In the foraminiferal literature for the year 1947 the following *nomina nuda* were noted (or names of Foraminifera which are regarded as such until complete references are available):

In Lit. No. 17 of the preceding Bibliography, the following new genera are cited:

ACOSTINA
ASTERIGERINELLA
CARPENTERELLA
COMPRESSIGERINA
OLSSONINA

In Lit. No. 28, *DUNBARULA mathieui* Ciry, *nov. gen., nov. spec.* from the upper Permian of southern Tunisia is mentioned. Information as to this new genus and species, asked for by letter, has not been received from the author.

In Lit, No. 98, *Hantkenina zelandica* Fin., is mentioned on p. 232. Whether this new species has been duly described and figured, is not known to the compiler.

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FORAMINIFERA IN THE UPPER TERTIARY OF EGYPT[1]

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ABSTRACT—A condensed summary is presented on the distribution of Foraminifera in Egyptian sediments of Oligocene, Miocene and Pliocene age.

THE FOLLOWING brief notes are based on a six-month research study of the post-Eocene washed residues in the collection of The Standard Oil Company of Egypt, S.A. Lack of any detailed papers on the subject since Macfadyen's of 1930 is considered to justify publication of the main conclusions reached.

LOWER OLIGOCENE[2]

Most of the upper Tertiary rocks of Egypt lie transgressively on Eocene or older beds, but locally some lower Oligocene shales are preserved below the unconformity. At such places the top of the Eocene is marked by abrupt disappearance of *Bulimina jacksonensis*, *Hantkenina* spp., *Globorotalia cocoaensis* although the bulk of the fauna passes with little change into the overlying Oligocene. Of particular interest are the following pelagic species which range above the top of the Eocene:

Globigerina concinna
Globigerina dissimilis
Globigerina "triloculinoides"
Globigerina cf. *wilsoni*
Globorotalia centralis var.

There is a remarkable similarity to the group of pelagic species which characterize the lower Oligocene of Ecuador and neighboring countries (Stainforth 1948).

MIOCENE

Beds basal to the first post-Eocene transgression probably include Chattian and Aquitanian elements, judging from the geological history of the eastern Mediterranean (cf. Little 1945, pp. 59, 60, bibliography: Sandford 1944: Arni 1940). Macfadyen (*l. c.*) only hesitantly admits the presence of pre-Burdigalian, post-Eocene beds in the Gulf of Suez, but his conclusions are based partly on paleogeographic correlation with rather remote parts of the Mediterranean, and partly on echinoid determinations by R. Fourtau (1920) which tend to have been dated younger than in more recent studies by the Italian school of geologists in Libya (*fide* M. Marchetti, private report).

The Foraminifera do not assist in settling the age of the basal transgressive beds. The appearance of large-apertured species of *Globigerinoides* may be taken as evidence of post-mid-Oligocene age,[3] but this is already

[1] Published by permission of The Standard Oil Company of Egypt, S.A. Cordial acknowledgment is made to D. B. Eicher and others of the company's geological staff in Cairo for guidance and assistance in the research.

[2] The writer here expresses his personal opinion as to age, based on the suite of pelagic Foraminifera which defines the Eo-Oligocene boundary in the Caribbean region. The term Lower Oligocene is thus used in the American sense, which may not be strictly synchronous with European and Mediterranean usage. The Geological Department of Anglo-Egyptian Oilfields Ltd. kindly reviewed the manuscript and expressed the opinion that the absence of the three Caribbean Eocene species listed is not, in Egypt, evidence of post-Eocene age, especially since "the principal occurrences of the undoubted Eocene species *Nummulites contortus* Deshayes and *N. striatus* Bruguière are found above the level of disappearance of all these species." The problem thus raised deserves further attention: on the one hand the writer may have generalized too far on the results of a brief study; on the other hand the value of pelagic Foraminifera in long-range correlation should not be dismissed too lightly, especially in a case where Tethyan communication can be postulated.

[3] Henson (1938, p. 231, 232 and chart) indicates the appearance of *Globigerinoides* as early as the Eocene, but from private reports it seems that he included forms with the same chamber arrangement but with supplementary apertures insignificant or lacking (cf. *Globigerinoides triloba* and

fully apparent from other evidence. With very few exceptions the Miocene species of small Foraminifera are long-ranging and the assemblages reflect predominantly the facies in which they lived. Macfadyen (1930, p. 41) recognized this as the reason underlying his inability to establish a rigid foraminiferal zonation within the *Globigerina* Marls of the Gulf of Suez. The principal facies-variants are:

(i) A moderately deep marine facies with a rich microfauna characterized by plentiful Lagenidae and nodosarians and the presence of *Pullenia* spp., *Plectofrondicularia* spp., *Baggina indica*, *Technitella nitida*, *Nonion pompilioides*, etc.
(ii) A shallower facies with a more limited fauna. Species tending to be conspicuous include *Cibicides praecinctus*, *Uvigerina barbatula* and *U. bononiensis*.
(iii) Littoral and reefal facies with specialized forms such as *Miogypsina*, *Heterostegina*, Peneroplidae and Alveolinellidae.

As one criterion of his locally recognizable upper zone Macfadyen (*l.c.*, p. 38) noted the presence in some abundance of *Candorbulina universa* and *Globigerinoides rubra*. This observation can be included in a zonation based on pelagic species only, and the present writer has found that with one exception all sections of the *Globigerina* Marls can be grouped under two zonal units on this basis. The faunal characteristics of the two zones are:

Upper Zone
Globigerinoides rubra and/or *Candorbulina universa* conspicuous.
Globigerina concinna, *Globigerina* aff. *venezuelana* and *Globigerinoides conglobata* absent or inconspicuous.
Globorotalia cf. *barissanensis* absent.
Lower Zone
Globigerinoides rubra and *Candorbulina universa* absent or inconspicuous.
Globigerina concinna, *G.* aff. *venezuelana* and *Globigerinoides conglobata*. One or more of these generally conspicuous.
Globorotalia aff. *barissanensis*. Sporadically present, occasionally common.
Both Zones
Globigerina bulloides, *Globigerinoides triloba* and *Globigerinella aequilateralis* liable to occur in abundance at all levels.

The exception referred to above is in the Ayun Musa area of Sinai, some 20 miles southwest of Suez, especially at Macfadyen's Locality No. 14 in Wadi el Bir. The marl at this point contains a remarkably rich fauna which includes an abundance of the pelagic marker-species of both zones. This anomaly is not fully explained, but tentatively it is suggested that the faunal change used in defining the zones is affected by facies conditions. The value of pelagic organisms as age indicators normally lies in their freedom from facies control, but this generalization applies only to open-sea deposits. The Gulf of Suez was an unusual form of basin, rather an elongate trough with only a narrow connection to the open Mediterranean. The zonal boundary under discussion falls in the upper Burdigalian and coincides with the beginning of the phase of isolation which culminated in desiccation and the formation of thick Helvetian evaporites. These end-of-cycle conditions indicate steadily increasing salinity and surface temperatures, factors which might well have caused a change in the upper Burdigalian pelagic faunas, especially in the southern part of the Gulf. The anomaly near Ayun Musa could then be attributed to its northern position and proximity to the main Mediterranean province, but an obstacle to accepting this is the validity of the pelagic zonation still farther north at Habashi.

In the Western Desert the age-equivalents of the *Globigerina* Marls and overlying evaporites of the Gulf of Suez are mainly shallow marine limestones. Microfaunas are sparse, consisting of a *Rotalia-Elphidium-Discorbis* suite of no zonal value. The appearance of *Borelis melo* characterizes upper Vindobonian levels. Pelagic Foraminifera are seldom encountered, but *Globigerinoides conglobata* appears to range definitely higher than in the Gulf of Suez marls, a factor with a slight bearing on the foregoing discussion.

PLIOCENE

At the surface near Dishet el Dhaba, a few miles south of Hurghada, and in some wells a rich foraminiferal fauna has been found in sediments directly overlying the Miocene evaporites. The assemblage contains few of the forms abundant in the underlying

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Globigerina "*triloculinoides*"). The present writer applies *Globigerinoides* only to forms with conspicuous supplementary apertures, as in the original designation of the genus (Cushman 1927, p. 87).

Miocene and includes fresh genera and species-groups such as large *Robulus* sp. with umbilical nodes, large *Rotalia* sp., *Globigerinoides elongata*, a lofty species of *Cymbaloporetta*, and other distinctive forms. This fauna is considered to be of Pliocene age, representing the second post-Eocene subsidence of the region, and it may include Indian Ocean forms.

SYSTEMATIC NOTES ON SPECIES LISTED ABOVE

Original descriptions are designated only by name and date, since further details are readily obtainable from the Catalogue of Foraminifera (Ellis and Messina).

Technitella nitida Heron-Allen and Earland 1932. The Egyptian specimens are usually flattened but appear closest to this species.

Nonion pompilioides (Fichtel and Moll). See *Nautilus pompiloides* F. and M. 1798. This is recorded by Macfadyen as *Nonionina pompilioides* (*l.c.* p. 104)

Borelis melo (Fichtel and Moll). See *Nautilus melo* F. and M. 1798, *Borelis melonoides* de Montfort 1808.

Bulimina jacksonensis Cushman 1925. The Egyptian specimens appear identical with this well-known American species. Macfadyen records a single broken specimen of *B. sculptilis* or *jacksonensis* from Miocene Marls (*l.c.* p. 55) but this occurrence is not confirmed by the present studies. Reworked Eocene and Cretaceous microfossils frequently occur near the transgressive base of the Miocene beds.

Uvigerina barbatula Macfadyen 1930 (*l.c.* p. 92, pl. 3, f. 26).

Uvigerina bononiensis Fornasini 1888. This species is noted by Macfadyen (*l.c.* p. 93, pl. 3, f. 29).

Baggina indica (Cushman). See *Pulvinulina indica* Cushman 1921. This species is noted by Macfadyen (*l.c.* p. 101, pl. 4, f. 13).

Globigerina bulloides d'Orbigny 1826. This species is noted by Macfadyen (*l.c.* p. 94, pl. 4, f. 2). The form seems close to the original type, cf. topotypes figured by Cushman (1941, p. 38, pl. 10, ff. 1–13).

Globigerina concinna Reuss 1850. See also Cushman (1936, p. 20, pl. 4, ff. 11–15). This species ranges much higher in Egypt than in the Caribbean region.

Globigerina dissimilis Cushman and Bermudez 1937. Egyptian specimens seem identical with the form figured from Ecuador (Stainforth 1948, p. 119, pl. 25, ff. 29–31) in all respects except that the supplementary chamber bridging the aperture is often lacking.

Globigerina "triloculinoides" Beck 1943, *non* Plummer 1926. Reference to the occurrence of this species in America has been made by Stainforth (1948, p. 117, pl. 25, ff. 32, 33). It may be the species mentioned in the type description of *G. triloculinoides* Plummer but distinguished as being larger, having a less conspicuous umbilical lip, and occurring in higher Eocene than Midway and in Oligocene strata in Texas.

Globigerina aff. *venezuelana* Hedberg 1937. This species was recorded by Macfadyen (*l.c.* p. 101, pl. 4, f. 14) as "*Pulvinulina crassa*" (*Rotalina crassa* d'Orbigny 1840) but it bears little resemblance to the type figure of that Cretaceous species. The aperture indicated by Macfadyen is considered to be an accidental feature of loosely coiled specimens, since it is absent in the numerous more compactly coiled individuals. The gaping square umbilicus is the most constant feature. It seems to belong to the *G. venezuelana* group, but is closer to specimens figured from Jamaica (Cushman and Jarvis 1930, p. 366, pl. 34, f. 5), Trinidad (Cushman and Stainforth 1945, p. 67, pl. 12, f. 13) and Ecuador (Stainforth 1948, p. 119, pl. 25, ff. 26–28) than to the type figure from Venezuela.

Globigerina cf. *wilsoni* Cole 1927. An identical species is described from the upper Eocene and lower Oligocene of Ecuador (Stainforth 1948, p. 117, pl. 26, ff. 1–3).

Globigerinoides conglobata (*Brady*). See *Globigerina conglobata* Brady 1879. This species is recorded in the American upper Tertiary (Stainforth 1948, p. 121, pl. 26, f. 4).

Globigerinoides elongata (d'Orbigny). See *Globigerina elongata* d'Orbigny 1826. This distinctive species is readily recognized from the topotypes figured by Cushman (1941, pl. 10, ff. 16–18).

Globigerinoides rubra (d'Orbigny). See *Globigerina rubra* d'Orb. 1839. The Egyptian form is figured by Macfadyen (*l.c.* pl. 4, f. 3) but the rate of increasing size of successive chambers is often lower than in the specimen chosen.

Globigerinoides triloba (Reuss). See *Globigerina triloba* Reuss 1850. This is figured from the *Globigerina* Marls by Macfadyen (*l.c.* pl. 4, f. 4). Topotypes have been figured by Cushman, who notes synonymy with *Globigerinoides trilocularis* (d'Orb.) (1946, pp. 20, 21, pl. 4, ff. 16–18).

Globigerinella aequilateralis (Brady). See *Globigerina aequilateralis* Brady 1879. This species is figured by Macfadyen under *Globigerina cretacea*, though he mentions similarity to the form named here (*l.c.* p. 94, pl. 4, f. 1).

Candorbulina universa Jedlitschka 1933. Macfadyen (*l.c.* p. 96) lists *Orbulina universa* from the Egyptian Miocene, but all the specimens seen in the present study fall under *Candorbulina*. The bilobate form is present.

Globorotalia aff. *barissanensis* LeRoy 1939. The species from the lower zone of the *Globigerina* Marls belongs to this group but is slightly smaller and more regularly constructed dorsally.

Globorotalia centralis Cushman and Bermudez 1937 var. The variety in question is an inflated form noted from Eocene and lower Oligocene beds in the Caribbean region (Stainforth 1948, p. 118, pl. 26, ff. 27–29).

Globorotalia cocoaensis Cushman 1928. This is

probably the unfigured *G. crassaformis* (G. and W.) of Henson (1938, p. 231 and chart, p. 229), but *Globigerina crassaformis* Galloway and Wissler 1927 was described from Pleistocene material. *G. cocoaensis* is widely distributed in the American Upper Eocene and has been recorded in the Eocene of Morocco (Ostrowsky 1938, pp. 344, 345).

Cibicides praecinctus (Karrer). See *Rotalia praecincta* Karrer 1868. Macfadyen (*l.c.* p. 98) records this species under *Truncatulina*.

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NEW MIOCENE FORAMINIFERA FROM JAPAN

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ABSTRACT—The Foraminifera from the Kokozura formation at Kokozura, Nakoso-Machi, Ishiki-Gun, Fukushima-Ken, comprise a faunal assemblage quite different from that of the Japanese Pliocene formations. There are many planktonic Globigerinidae and Globorotaliidae aside from the predominating forms of the Nodosariidae and Buliminidae. The latter families include neritic or deep water forms indicating that the Kokozura formation is not a littoral or shallow water deposit. This view is upheld by the rare occurrence of the Miliolidae and Textulariidae. Among the 68 species discriminated only the new forms are described. Data obtained from the foraminiferal fauna indicate a Miocene age for the formation.

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INTRODUCTION

The occurrence of fossil foraminifers from the Tertiary deposits of the Jô-Ban coalfields was first made known by Professor Shôshirô Hanzawa in 1946, during his geological observations of the formations there. He discovered many well preserved specimens in the sandy shale beds of the Kokozura formation exposed at the type locality at Kokozura, in Nakoso-Machi, Ishiki-Gun, Fukushima-Ken, where they, with several layers of sandstone, unconformably overlie the next older Nakayama formation.

The Taga group of the late Dr. Kyukichi Watanabe corresponds in part to the formation from which the present collection was made. The present study reveals the Kokozura to be Miocene as shown by the occurrence of the characteristic fossil, *Sagarites chitanii* Makiyama and molluscs recently studied by K. Hatai. The new formation name, Kokozura, should be adopted for the deposits to avoid confusion because the Taga group includes a wide range of strata.

The foraminiferal fauna from the Kokozura formation is very interesting because it includes *Ceratobulimina*, *Pseudoparrella* and *Rotalia trispinosa* Thalmann, warm water forms which are now common in tropical and sub-tropical seas but seldom frequent the waters bordering Japan, because its composition is quite different from faunas prevailing in the Japanese Pliocene formations; and because many characteristic and new species occur as shown in the following list.

FOSSIL FORAMINIFERA FROM THE KOKOZURA FORMATION

Textulariidae (2 species)	
Textularia candeiana d'Orbigny	rare
T. agglutinans d'Orbigny	rare
Verneuilinidae (1 species)	
Pseudogaudryina ishikiensis, n. sp. (Fig. 1, *nos. 61–64*)	common
Miliolidae (4 species)	
Quinqueloculina lamarckiana d'Orbigny	rare
Massilina arenaria (Brady)	rare
Triloculina circularis Bornemann	rare
T. trigonula (Lamarck)	rare

Nodosariidae (29 species)	
Robulus limbosus (Reuss) (Fig. 2, *nos. 5, 6*)	abundant
R. pseudorotulatus Asano	rare
R. iotus (Cushman) (Fig. 1, *no. 1*)	few
R. sagamiensis Asano (Fig. 2, *no. 7*)	rare
R. calcar (Linné)	few
R. sp.	rare
Marginulina sendaiensis Asano (Fig. 1, *nos. 1, 12*)	few
M. cf. *uedai* Asano (Fig. 1, *nos. 15, 23, 25*)	few
Dentalina communis d'Orbigny (Fig. 1, *nos. 14, 26*)	few
D. sp. (Fig. 1, *no. 16*)	rare
Nodosaria insecta Schwager (Fig. 1, *nos. 13, 22*)	few
N. kokozuraensis, n. sp. (Fig. 1, *no. 2*)	few
N. vertebralis (Batsch) (Fig. 1, *no. 3*)	rare
N. raphana (Linné) (Fig. 1, *no. 38*)	few
Saracenaria italica Defrance	common
Lagena acuticosta Reuss Fig. 1, *no. 35*)	few
L. globosa (Montagu) (Fig. 1, *no. 33*)	rare
L. clavata (d'Orbigny) (Fig. 1, *no. 32*)	rare
L. cf. *hexagona* (Williamson)	few
L. sulcata apiculata Cushman (Fig. 1, *nos.* 29, 30)	few
L. sulcata interrupta Williamson (Fig. 1, *nos. 27, 36*)	few
L. ovum Ehrenberg (Fig. 1, *no. 39*)	rare
L. striata strumosa Reuss (Fig. 1, *no. 34*)	rare
L. striata d'Orbigny (Fig. 1, *no. 31*)	few
L. semistriata Williamson (Fig. 1, *no. 28*)	rare
L. substriata Williamson (Fig. 1, *no. 49*)	rare
L. sp.	rare
Lagenondosaria fukushimaensis, n. sp. (Fig. 1, *nos. 4–11, 20, 21*)	abundant
L. scaloris (Batsch) (Fig. 1, *nos. 17–19*)	few
Frondicularíidae (1 species)	
Frondicularia interrupta Karrer (Fig. 1, *no. 24*)	rare
Polymorphinidae (3 species)	
Guttulina cf. *pacifica* Cushman and Ozawa	rare
G. yabei Cushman and Ozawa	rare
G. sp.	rare
Nonionidae (6 species)	
Nonion nakosoense, n. sp. (Fig. 2, *nos. 14–17*)	abundant
N. scaphum (Fichtel and Moll)	few
N. japonicum Asano	rare
Nonionella miocenica Cushman (Fig. 1, *nos. 18–20*)	abundant
Astrononion stelligerum (d'Orbigny)	rare
Elphidium cf. *fabum* (Fichtel and Moll) Fig. 2, *nos. 21–22*)	few
Buliminidae (10 species)	
Buliminella hanzawai, n. sp. (Fig. 1, *nos. 54, 55*)	few
Bulimina elegans d'Orbigny (Fig. 1, *nos. 57, 58*)	few
Globobulimina pacifica Cushman	rare
Virgulina complanata Egger (Fig. 1, *no. 59*)	rare
V. ishikiensis, n. sp. (Fig. 1, *nos. 45, 46, 48, 56*)	few
V. cf. *pauciloculata* Brady (Fig. 1, *no. 47*)	rare
Bolivina cf. *alata* (Sequenza) Fig. 1, *no. 44*)	rare
Uvigerina mediterranea Hofker (Fig. 1, *nos. 40–43*)	abundant
U. cf. *bifurcata* d'Orbigny (Fig. 1, *no. 37*)	few
Angulogerina kokozuraensis, n. sp. (Fig. 1, *nos. 50–53*)	few
Rotaliidae (7 species)	
Discorbis sp.	rare
Eponides karsteni (Reuss)	few
Rotalia beccarii (Linné)	common
R. trispinosa Thalmann	few
R. sp.	rare
Cancris auricula (Fichtel & Moll)	rare
Baggina totomiensis Makiyama (Fig. 2, *nos. 8–13*)	abundant
Cassidulinidae (2 species)	
Ceratobulimina hanzawai, n. sp. (Fig. 2, *nos. 23–27*)	abundant
Pseudoparrella japonica, n. sp. (Fig. 2, *nos. 2–4*)	few
Globigerinidae (Planktonic)	abundant
Globorotaliidae (Planktonic)	few

Anomalinidae (3 species)	
Hanzawaia tagaensis, n. sp. (Fig. 2, *nos. 28–32*)	abundant
Cibicides lobatulus (Walker and Jones)	rare
C. pseudoungerianus (Cushman)	rare

PALEOECOLOGY

Planktonic Globigerinidae and Globorotaliidae are not included in the list but they are also abundant. The Nodosariidae and the Buliminidae, known, to be generally neritic or deep water forms, are most dominant in both number of species and individuals. The rare occurrence of species belonging to the Miliolidae and Textulariidae are an indication that the formation is not a littoral or shallow water deposit. Most of the other species, except for the new ones, are common in the North Pacific Ocean, but some are characteristic of the Malay Region.

Of considerable interest is the presence of *Rotalia trispinosa* Thalmann, a tropical to subtropical species of the Indo-Pacific Ocean. *Ceratobulimina* and *Pseudoparrella* are found commonly in the neritic waters of the same region, but their occurrence in the collection at hand is their first record from Japan, either fossil or recent. *Ceratobulimina contraria* (Reuss) recorded by Professor Hanzawa from the Pliocene Shimajiri formation of the Ryûkyû Islands is distinguishable from the present form. The dominant occurrence of *Ceratobulimina* in the Kokozura formation is important in a consideration of the ecology of the deposits.

This evidence indicates the neritic nature of the deposits which appear to have accumulated in a warm or sub-tropical region.

GEOLOGICAL SIGNIFICANCE

Among the total of 68 species, excluding the pelagic foraminifers, *Marginulina sendaiensis* Asano was originally described from the Miocene Moniwa formation near Sendai, and later found in the Pliocene formations in the Bôsô Peninsula. The present specimens of this species (Fig. 1, *nos. 1, 12*), however, have the costae more prominent than those from the Moniwa and the arrangement of the chambers more curved than those of the Pliocene, but these differences may only be local variation and the species is considered to range from the Miocene to the Pliocene.

Nonionella miocenica Cushman is more abundant than might be expected because it is characteristic in the Miocene of Northwest America, and has not yet been found in the Pliocene of Japan which is characterized by *Nonionella pulchella* Hada.

The Kokozura assemblage has little affinity with the Pliocene fauna of Japan and most of the new species are distinguishable from the Japanese Pliocene forms.

Nonion nakosoense, n. sp., which is very closely related with the European Miocene species, *N. boueanum* (d'Orbigny) differs from the Japanese Pliocene and Recent species of *N. japonicum* Asano by its broader test. *Hanzawaia tagaensis*, n. sp., is replaced by *H. nipponica* Asano in the Pliocene of Japan. The same relationship is also found between *Lagenonodosaria sagamiensis* Asano (Pliocene) and *L. fukushimaensis*, n. sp., and also between *Pseudogaudryina oga* Asano (Pliocene) and *P. ishikiensis*, n. sp. Other new forms, such as *Ceratobulimina hanzawai*, *Pseudoparrella japonica*, *Angulogerina kokozuraensis*, and, *Virgulina ishikiensis*, are characteristic of the fauna and are unknown from the Japanese Pliocene.

In general, the Kokozura foraminiferal fauna includes an assemblage of forms indicating that the strata in which these fossils occur are geologically older than those carrying the Pliocene Foraminifera referred to. Further, a comparison of the warm water Pliocene Kakegawa fauna with the present warm or subtropical assemblage shows that there are no characteristic species in common, except for *Baggina totomiensis* Makiyama. This fact clearly proves that the Kokozura fauna cannot be ascribed to an age as young as the Kakegawa. Finally, on the basis of the presence especially of *Nonionella miocenica* Cushman, together with *Sagarites chitanii* Makiyama, the age of the foraminiferal assemblage from the Kokozura formation may be regarded as definitely Miocene.

DESCRIPTION OF NEW SPECIES

All of the species described below are from a single locality, Kokozura, Nakoso-Machi, Ishiki-Gun, Fukushima-Ken. The type specimens are in the collection of the Institute of Geology and Paleontology, Tôhoku Imperial University, Sendai, Japan.

PSEUDOGAUDRYINA ISHIKIENSIS
Asano, n. sp.
Figure 1, *nos. 61–64*

Test slightly longer than broad, triangular in transverse section, early chambers triserial, later biserial, angles subacute; sutures indistinct, sometimes depressed; wall arenaceous, somewhat varied in texture; aperture a low opening near inner margin of last formed chamber. Length up to 1.0 mm.

Holotype.—Cat. no. 67039.

The texture of the wall and the indistinct sutures distinguish this species from *Pseudogaudryina ellisorae* Cushman, and its more triangular test in transverse section differentiates it from *P. oga* Asano.

LAGENONODOSARIA FUKUSHIMAENSIS
Asano, n. sp.
Figure 1, *no. 4;* figure 2, *nos. 20, 21*

Test elongate, composed of more than 10 chambers in adult, apical end often with few spines, surface ornamented with numerous longitudinal raised costae; phialine aperture at end of long-neck ornamented with transverse ring-like costa or spicules. Length up to 5.5 mm.

Holotype.—Cat. no. 67042.

The larger number of chambers and comparatively large size of the test distinguishes this species from both *Lagenonodosaria scalaris* (Batsch) and *N. scalaris sagamiensis* Asano.

NODOSARIA KOKOZURAENSIS Asano, n. sp.
Figure 1, *no. 2*

Test elongate, slightly curved, nodosarian, having 10 or more chambers in adult; surface often ornamented with weak striations, especially on lower half of each chamber; sutures depressed, not oblique;

EXPLANATION OF FIGURE 1

FIG. *1, 12—Marginulina sendaiensis* Asano, ×30. (p. 424)
2—Nodosaria kokozuraensis Asano, n. sp., ×30. (p. 426)
3—Nodosaria vertebralis (Batsch), ×30. (p. 424)
4–11, 20, 21—Lagenonodosaria fukushimaensis Asano, n. sp. Figs. *4, 5, 10, 11,* ×30; figs. *6–9,* ×55; figs. 20, 21 ×40. (p. 426)
13, 22—Nodosaria insecta Schwager, ×25. (p. 424)
14, 26—Dentalina communis d'Orbigny, ×25. (p. 424)
15, 23, 25—Marginulina cf. *uedai* Asano, ×25. (p. 424)
16—Dentalina sp., ×25. (p. 424)
17–19—Lagenonodosaria scalaris (Batsch), ×30. (p. 424)
24—Frondicularia interrupta Karrer, ×30. (p. 428)
27, 36—Lagena sulcata interrupta Williamson, ×30. (p. 428)
28—Lagena semistriata Williamson, ×30. (p. 424)
29, 30—Lagena sulcata apiculata Cushman, ×30. (p. 424)
31—Lagena striata d'Orbigny, ×30. (p. 424)
32—Lagena clavata d'Orbigny, ×30. (p. 424)
33—Lagena globosa (Montagu), ×30. (p. 424)
34—Lagena striata strumosa Reuss, ×30. (p. 424)
35—Lagena acuticosta Reuss, ×30. (p. 424)
37—Uvigerina cf. *bifurcata* d'Orbigny, ×30. (p. 424)
38—Nodosaria raphana (Linné), ×25. (p. 424)
39—Lagena ovum Ehrenberg, ×30. (p. 424)
40–43—Uvigerina mediterranea Hofker, ×30. (p. 424)
44—Bolivina cf. *alata* (Sequenza), ×30. (p. 424)
45, 46, 48, 56—Virgulina ishikiensis Asano, n. sp., ×30. (p. 428)
49—Virgulina cf. *pauciloculata* Brady, ×30. (p. 428)
50–53—Angulogerina kokozuraensis Asano, n. sp., ×30. (p. 424)
54, 55—Buliminella hanzawai Asano, n. sp., ×30. (p. 428)
57, 58—Bulimina elegans d'Orbigny, ×30. (p. 424)
59—Virgulina complanata Egger, ×30. (p. 424)
60–64—Pseudogaudryina ishikiensis Asano, n. sp., ×30. (p. 426)

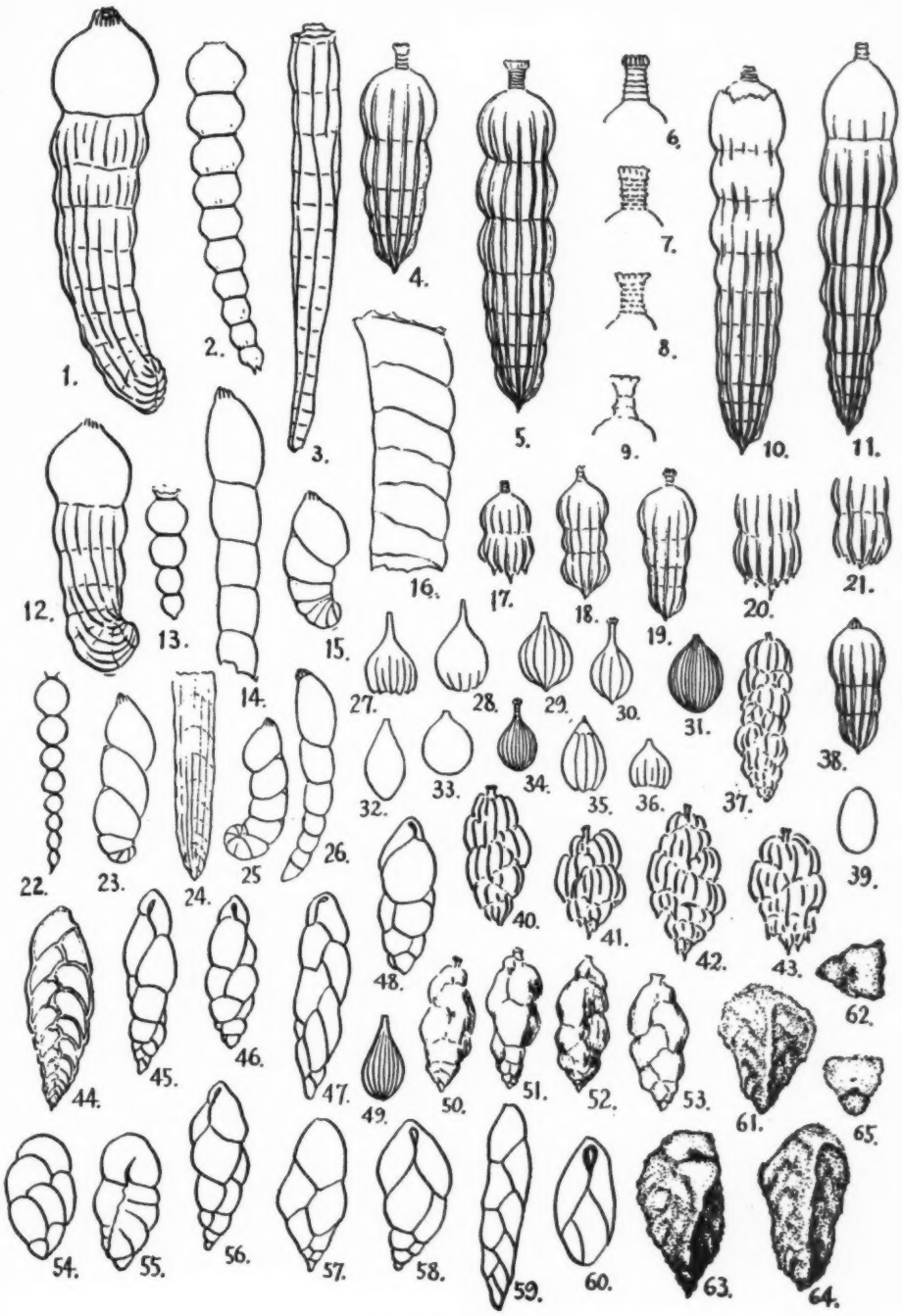
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FIG. 1, *nos. 1–64*

proloculus with short spinous projections. Length up to 3 mm.

Holotype.—Cat. no. 67043.

This species is related to *Nodosaria insecta* Schwager, but is less constricted.

NONION NAKOSOENSE Asano, n. sp.
Figure 2, *nos. 14–17*

Test broadly oval, bilaterally symmetrical, composed of 14 chambers in last coil; umbilical region covered with granular shell material from which curved sutures radiate; periphery subacute; wall smooth, aperture a narrow slit at basal margin of apertural face. Length up to 1.2 mm.

Holotype.—Cat. no. 67044.

The more broadly oval test and greater number of chambers distinguish this species from *Nonion japonicum* Asano, a common Pliocene species of Japan.

BULIMINELLA HANZAWAI Asano, n. sp.
Figure 1, *nos. 54, 55*

Test elongate, about twice as long as broad, tapering at initial end, but very broadly rounded at distal end; chambers numerous, composed of three inflated whorls; sutures distinct, depressed; wall smooth; aperture comma-shaped, in depressed face of last-formed chamber. Length up to 0.8 mm.

Holotype.—Cat. no. 67048.

The shape of the aperture and the regular whorls of chambers distinguishes this species from *Buliminella subteres* (Brady).

VIRGULINA ISHIKIENSIS Asano, n. sp.
Figure 1, *nos. 45, 46, 48, 56*

Test elongate, subfusiform, about three times as long as broad, periphery somewhat lobulate; chambers distinct, numerous, inflated, twisted, nearly as high as broad, increasing slightly in size as added; sutures distinct, depressed; wall smooth, finely perforate; aperture elongate, narrow at base of inner margin of last formed chamber. Length 1 mm., breadth 0.3 mm., thickness 0.25 mm.

Holotype.—Cat. no. 67041.

This species seems to be intermediate between *Virgulina pauciloculata* Brady and *V. complanata* Egger.

ANGULOGERINA KOKOZURAENSIS
Asano, n. sp.
Figure 1, *nos. 50–53*

Test small, fusiform, subtriangular in transverse section; chambers numerous, somewhat inflated, ornamented with weak striations; sutures obscure but somewhat depressed; aperture terminal, with short neck and lip. Length up to 0.5 mm.

Holotype.—Cat. no. 67040.

This species is similar to *Angulogerina hughesi* (Galloway and Wissler), but the sutures are more obscure and the earlier chambers, are less inflated.

CERATOBULIMINA HANZAWAI
Asano, n. sp.
Figure 1, *nos. 23–27*

Test longer than broad, periphery broadly rounded, usually eight chambers in last coil, sutures distinct, slightly depressed, not limbate; wall smooth and polished; aperture rather large, broad and somewhat oblique in apertural face of last-formed chamber. Length 1.2 mm., breadth 0.8 mm., thickness 0.5 mm.

Holotype.—Cat. no. 67046.

This species is readily distinguished from the common Philippine species *Cerato-*

EXPLANATION OF FIGURE 2

FIG. *1—Robulus iotus* (Cushman), ×25. (p. 424)
2–4—Pseudoparrella japonica Asano, n. sp., ×30. (p. 424)
5, 6—Robulus limbosus (Reuss), ×25. (p. 424)
7—Robulus sagomiensis Asano, ×25. (p. 424)
8–13—Baggina totomiensis Makiyama, ×25. (p. 424)
14–17—Nonion nakosoense Asano, n. sp., ×25. (p. 428)
18–20—Nonionella miocenica Cushman, ×30. (p. 424)
21, 22—Elphidium cf. *fabum* (Fichtel and Moll), ×30. (p. 424)
23–27—Ceratobulimina hanzawai Asano, n. sp., ×25. (p. 424)
28–32—Hanzawaia tagaensis Asano, n. sp., ×25. (p. 425)

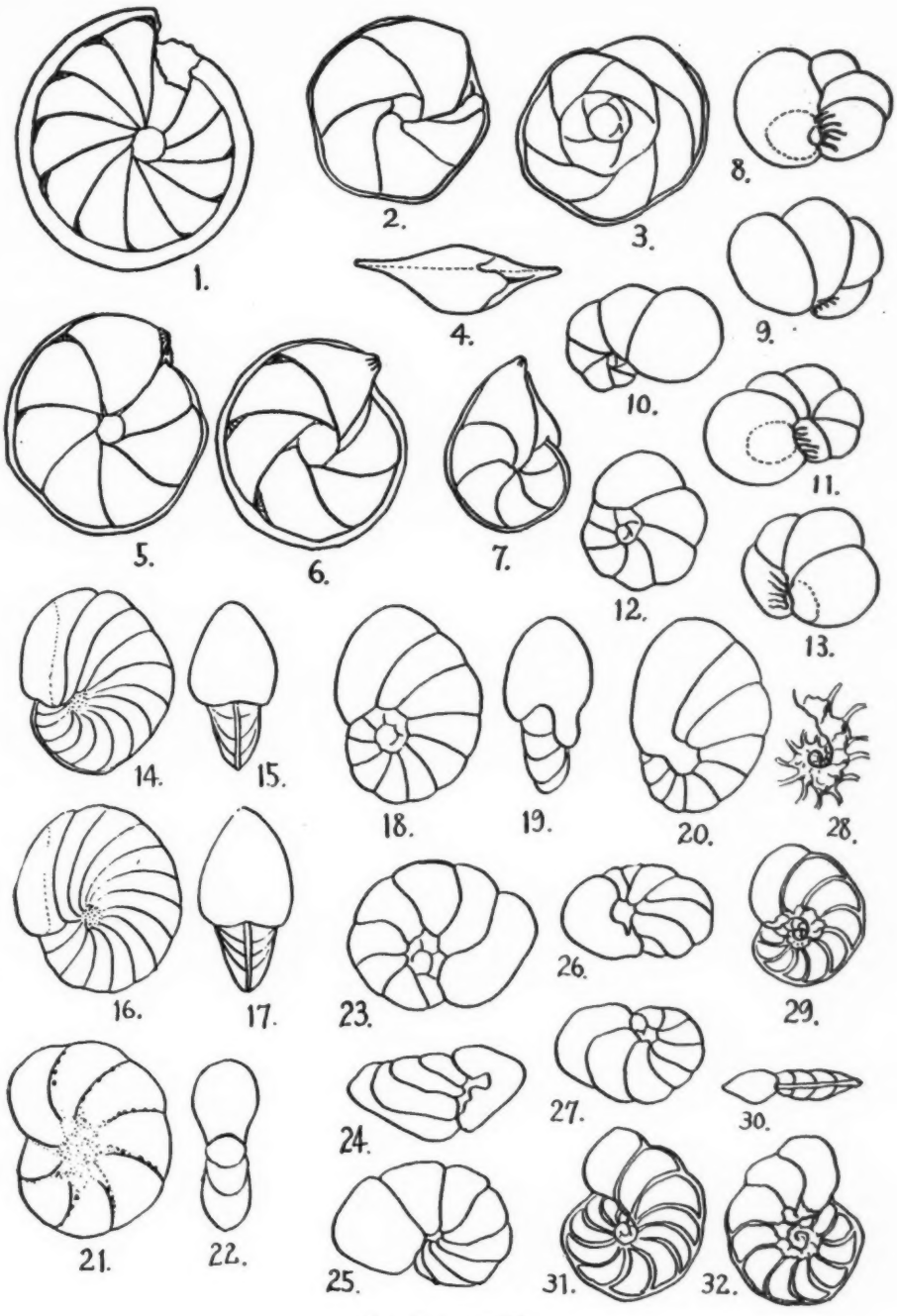
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FIG. 2, *nos. 1–32*

bulimina pacifica Cushman and Harris, by its shape in apertural view.

PSEUDOPARRELLA JAPONICA
Asano, n. sp.
Figure 2, *nos. 2–4*

Test trochoid, somewhat biconvex, umbonate, periphery acute; chambers about six in last coil; sutures on dorsal side strongly oblique, not depressed; wall smooth; aperture a narrow slit just parallel with periphery on apertural face of last formed chamber. Diameter about 0.5 mm.

Holotype.—Cat. no. 67045.

This is the first species of *Pseudoparrella* to be recorded from Japan.

HANZAWAIA TAGAENSIS Asano, n. sp.
Figure 2, *nos. 28–32*

Test compressed, early stages trochoid, later somewhat evolute; chambers narrow, about eleven in last coil, dorsal side nearly flat outside of umbilical area which is often umbilicated and with supplementary lobes; periphery somewhat extended, but not carinate; septal sutures distinctly limbate, curved, sometimes raised; wall coarsely perforate; aperture a short slit at periphery of last chamber. Diameter up to 1 mm., thickness 0.15 mm.

Holotype.—Cat. no. 67047.

The different form of the supplementary lobes of the umbilical region differentiates this species from *Hanzawaia nipponica* Asano.

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JOURNAL OF PALEONTOLOGY, VOL. 23, NO. 4, PP. 431–435, 4 TEXT FIGS., JULY 1949

PALEONTOLOGICAL NOTES

ON *HAGENOWELLA* AND A NEW SPECIES

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Drill cuttings, obtained at a depth of 525 metres from a well at America, Noord-Brabant province, Netherlands, which I studied through the kindness of the Geological Foundation of the Netherlands, have furnished more than 10 specimens of *Hagenowella*, associated with *Nodogenerina spinulosa* (Montague), *Bulimina trigonalis* Ten Dam and Reinhold, *Cibicides kryptomphalus* (Reuss). These three identified species are typical of the Paleocene foraminiferal faunas of the Netherlands. Because the specimens of *Hagenowella* are not worn and are not encrusted, as most Cretaceous Foraminifera of this region are, I am convinced, that this association is a natural one

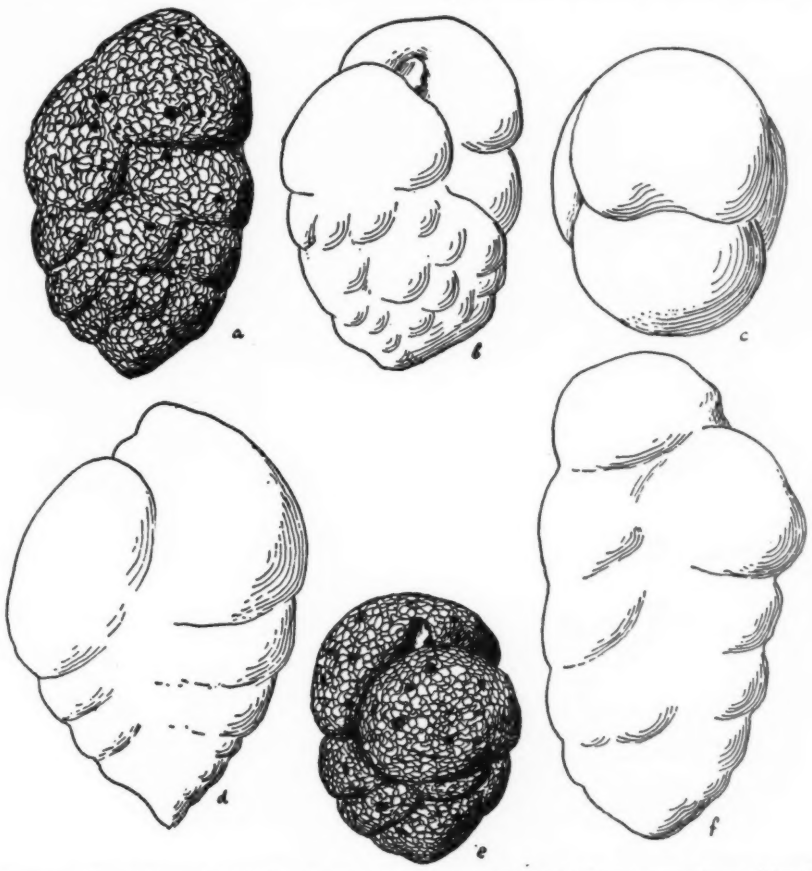

FIG. 1—*Hagenowella paleocenica* Hofker n. sp. *a*, *b*, *c:* megalospheric form from three sides; *d*, microspheric; *e* younger specimen, showing apertural lip; *f*, megalospheric with four sets of biserial chambers. ×50.

and that the genus is not restricted to the Upper Cretaceous as has been believed.

Cushman (1937, Monogr. Valvulinidae, Lab. Form. Res., spec. publ. 8, pp. 172–173) described *Hagenowella* as follows:

outer wall, partially dividing the periphery of each chamber; wall arenaceous, of calcareous and siliceous fragments, smoothly cemented; aperture oblique, elongate, from the inner margin, with a tooth. Cretaceous."

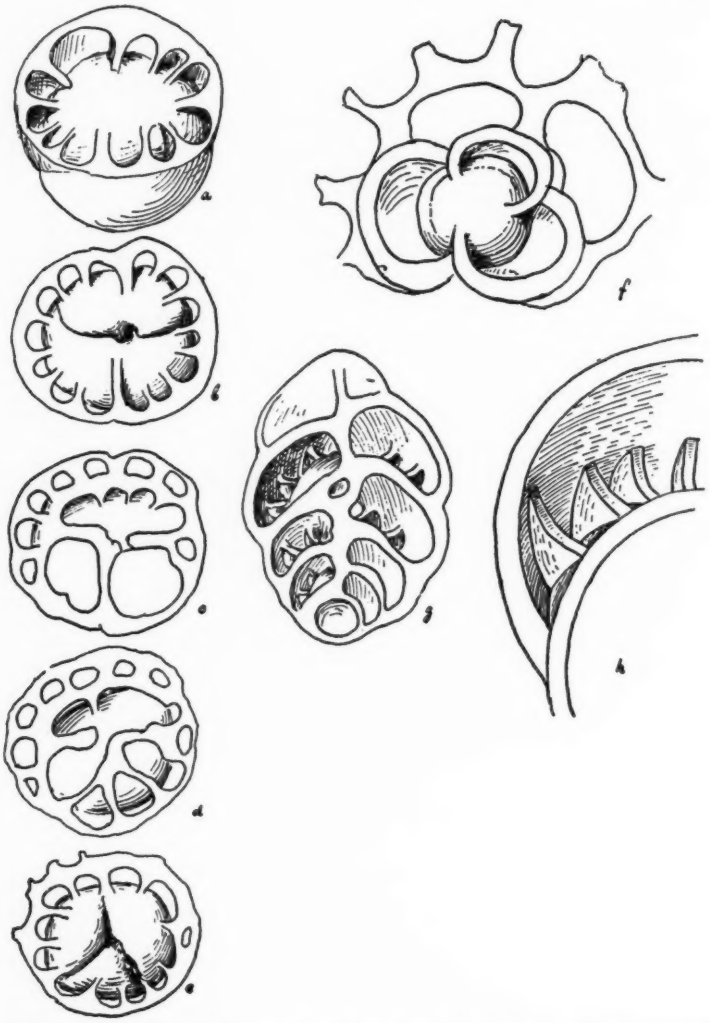

FIG. 2—*Hagenowella paleocenica* Hofker, n. sp. *a, b, c, d, e:* successive sections through megalospheric individual, from biserial to triserial stage, ×50; *f*, section through initial part of same specimen, showing proloculus, three chambers of first triserial set, and overlapping parts of second triserial set, ×240; *g*, longitudinal section through megalospheric specimen, showing septa, ×50; *h*, schematic drawing of chamber with septa.

"Test in a trochoid spiral, early portion with three or more chambers in a whorl, interior simple in the early stages, later with radial partitions growing in from the

Also regarding *H. advena* Cushman wrote (p. 174):

"Chambers . . . four in the last-formed whorl."

In spite of these statements *Hagenowella* is triserial from its initial end to where it changes to a biserial arrangement of its last-formed chambers in both megalospheric and microspheric forms, at least in the species obtained from the America well. Thus it is similar to *Gaudryina* except for its partitions. Mistakes regarding the number of chambers in the whorls have probably resulted from misinterpretations of sections which cut not only the chambers of one whorl but also the overlapping portions of the chambers in the preceding whorl.

If transverse sections are made beginning at the initial end, they cut almost immediately into the chambers of two whorls and four or five chambers more or less spirally arranged appear to be present. If, however, grinding is begun at the other end of the test, this mistake cannot be made, for the individual chambers can be followed and successively younger ones, make their appearance in the central area. Serial sections in this order show that triserial arrangement is continued to the proloculus but each whorl is overlapped about half way by the outer parts of later chambers. Partitions divide these overlapping parts of the chambers but they do not extend into the main central parts; they are restricted mainly to the parts near the outer walls.

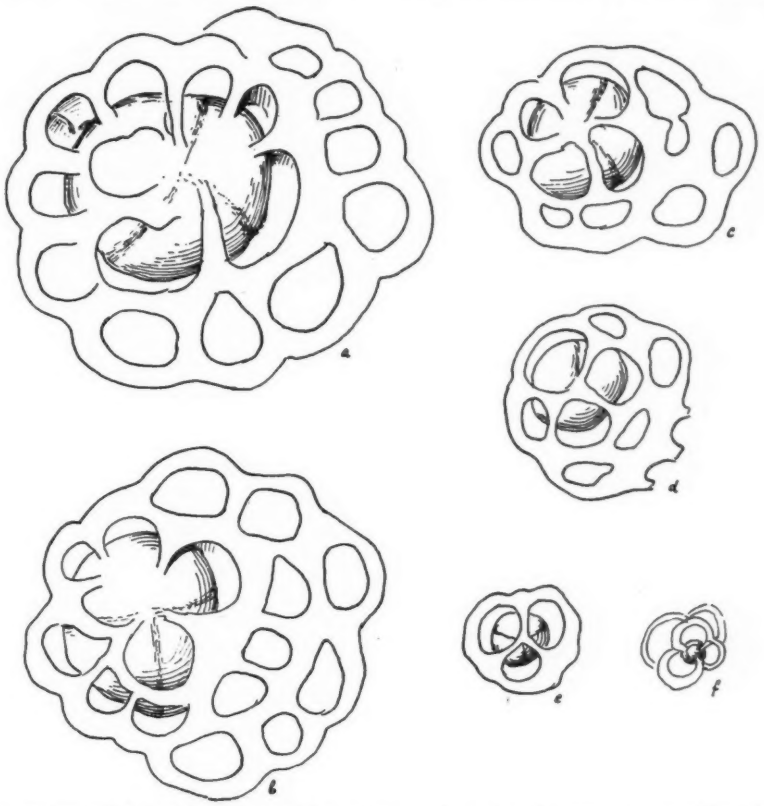

FIG. 3—*Hagenowella paleocenica* Hofker, n. sp., *a*, *b*, *c*, *d*, *e*, *f*: successive sections through initial part of microspheric specimen, ×240.

Similar grinding shows that *Karreriella bradyi* (Cushman) also begins with its chambers triserially arranged and it is doubtful if any verneuiline species has more than three chambers in its first whorl. However, it may be that all of the Valvulinidae were derived from ancestral Jurassic species, which had more than three chambers in the beginning of the test as in *Valvulina* itself.

HAGENOWELLA PALEOCENICA
Hofker n. sp.
Figures 1–3

Test may be twice as long as broad but generally shorter. Sutures in initial part indistinct, in apertural part somewhat sunken between inflated chambers. Chambers partly overlapping, all visible on exterior. Apertural end oblique, initial end rounded in megalospheric, pointed in microspheric individuals. Initial parts of microspheric specimens composed of at least four triserial whorls, followed by two sets of biserial chambers. Megalospheric specimens with at least three triserial whorls followed by as many as four pairs of biserial chambers. Aperture depressed, loop-shaped, at inner suture of last chamber, closed by a tooth.

Early chambers, at least in microspheric form, undivided, later ones with delicate peripheral longitudinally directed septa forming a series of chamberlets where later chambers overlap earlier ones.

Walls coarsely arenaceous, smooth externally, with many scattered black grains giving them a grey color.

Length up to 1 mm., diameter up to 0.6 mm.; transverse section more or less circular.

Diameter of proloculus: megalospheric 50 to 100μ, microspheric about 8μ.

Type specimen in the collection of the Geological Foundation of the Netherlands, Haarlem.

This species differs from that described by Cushman as *H. advena* in the following characters:

The last-formed coil does not make up almost the entire surface of the test; there are three, not four, and in the microspheric form only two chambers in the last-formed whorl; sutures between the last-formed chambers are depressed; length not 0.80 but up to 1 mm.; Paleocene.

From *H. gibbosa* (D'Orbigny) the new species differs as follows:

Test not short and broad, but more elongate; later chambers not four in a whorl; aperture not strongly oblique.

One might suspect that the new species does not belong to the genus *Hagenowella*. However, I am convinced that the description of *Hagenowella* in some way is incorrect, as in no known species of this group does the number of chambers increase in later whorls, but always decreases. There are many species of the Valvulinidae which have three or even more chambers in the earlier whorls but this number gradually diminishes to two or even to one. *Hagenowella* does not contradict this rule.

JAEKELICRINUS BASHKIRICUS
Yakovlev n. gen., n. sp.

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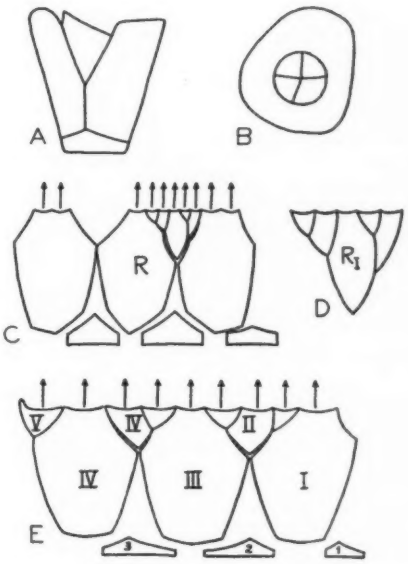
Due to an oversight no name was assigned to the type species of the crinoid genus, *Jaekelicrinus*, described by me in Doklady 1947, p. 609; and consequently, this genus has no standing. This note is designed to validate the genus and, because the previous description was in Russian, make it more readily available to paleontologists in other lands.

JAEKELICRINUS BASHKIRICUS
Yakovelev n. gen., n. sp.

The cup is a truncated pyramid about 1 cm. high and 3 mm. in diameter below with three flattened sides separated by rounded edges. Basals 3 or 4. Radials 6, 3 in the first zone large (echte RR of Jaekel), 3 in the second zone (R_1R_1) small, wedged in between the larger radials and not reaching to the basals. At the upper margin of the cup several tiny plates—the exact number cannot be determined because of imperfect preservation—separate the large and small radials. These are the "acceccorishe RR" of Jaekel or the "pararadialia" of Bather.

This crinoid is the last phyletic member of the pisocrinid series. Its nearest relative is *Calycanthocrinus* of the Lower Devonian which has a maximum of 12 accessory radials. *Jaekelicrinus* probably has 20.

Upper Devonian, from Lake Koltuban on the eastern slope of the Ural Mountains.



FIGS. *1a–e, a–d, Jaekelicrinus baskiricus* Yakovlev, n. gen. n. sp. ×2; *e, Calycanthocrinus* (after Jaekel).

JOURNAL OF PALEONTOLOGY, VOL. 23, NO. 4, PP. 436–440, JULY 1949

NOMENCLATURAL NOTES

NOMENCLATURAL NOTES ON *PULLENIA* AND *CIBICIDES*

R. M. STAINFORTH
Negritos, Peru

Type descriptions of the Foraminifera discussed below have been studied partly in the Catalogue of Foraminifera (Ellis and Messina 1940) and not in the original papers. C. W. Wright very kindly supplied information on Latin and Greek roots and their usage, and later offered useful criticism of the initial draft of this note.

Pullenia duplicata, new name for *Pullenia compressiuscula* Reuss 1866

The name *Pullenia compressiuscula* was introduced by Reuss (1866, p. 150) to replace *Nonionina quinqueloba* Reuss 1851. The change was explicitly stated to be based on the subsequent discovery of specimens identical except for having four instead of five chambers in the final coil. Reuss, evidently a purist, considered the specific name *quinqueloba* thus invalidated and replaced it by the neutral term *compressiuscula*. The four-chambered forms were separated as *P. compressiuscula* var. *quadriloba* Reuss 1867.

By the International Rules of Zoological Nomenclature a specific name once applied in a correct Linnaean manner cannot be altered merely because its meaning is inept for the organism in question. The case cited above is a clear-cut example of such incorrect re-naming. Therefore the name *P. compressiuscula* is invalid, the correct form being *P. quinqueloba* (Reuss 1851). If a different name is to be used for the four-chambered form it should be *P. quinqueloba* (Reuss) var. *quadriloba* Reuss 1867. The typical form thus automatically becomes *P. q. quinqueloba* (Reuss), of which *P. compressiuscula* var. *quinqueloba* Reuss 1867 is a synonym.

Cushman and Todd (1943) have listed the known species of *Pullenia* and discussed *P. quinqueloba* (Reuss 1851), *P. compressiuscula* Reuss 1865[1] and *P. quadriloba* Reuss 1867 (raised from varietal rank) as separate species (*op. cit.*, pp. 10, 12, 15 respectively). Cushman and Todd evidently based their distinction on the first figure named *P. compressiuscula* (in Reuss 1870) and consider it different from the original *P. quinqueloba*. Since *P. compressiuscula* was published as a new name synonymous with *P. quinqueloba* it cannot stand for a different species. Hence a new name is proposed as follows:

PULLENIA DUPLICATA Stainforth n. nom.

Pullenia compressiuscula of authors (not Reuss 1866, p. 150), e.g.
Cushman and Todd, Cushman. Lab. Foram. Res., Contr., vol. 19, p. 12, pl. 2, figs. 6–13. 1943.
Cushman and Stainforth, *loc. cit.*, Spec. Publ. no. 14, p. 66, pl. 12, fig. 8. 1945.
Cushman and Todd, *idem*, no. 15, p. 64, pl. 11, fig. 6. 1945
Cushman and Stone, *idem*, no. 20, p. 24, pl. 3, fig. 17. 1947
Cushman and Renz, *idem*, no. 22, p. 39. 1947
Cushman and Renz, *idem*, no. 24, p. 38, pl. 7, fig. 16. 1948

This new name is proposed because *P. compressiuscula* is by definition an exact synonym of *P. quinqueloba* (Reuss). Reuss (1866, 1870) and Cushman and Todd (1943) have commented on the intergradation between the various forms of *Pullenia* in the Septarian clays of Germany. Much confusion would be eliminated by referring all specimens of compressed, slightly lobulate *Pullenias* to the single species *P. quinqueloba* (Reuss). However, if slight differences in dimensional ratios are to be considered valid specific criteria the new name *P. duplicata* may replace the invalid *P. compressiuscula auct.*

[1] The reference is given at the end of this note under 1866, following Ellis and Messina (1940).

Gender of *Cibicides*

The foraminiferal genus *Cibicides* was erected by Denys de Montfort in 1808, but no clue was given as to the derivation of the name. In applying adjectival names to species of this genus most authors have used a masculine form, but others have used a feminine form and some have been inconsistent, using both forms at one time or another. De Montfort himself referred to "*le* cibicide," but his single specific name (*refulgens*) is inert as to gender. To establish the correct gender of *Cibicides* the writer referred the question to a friend familiar with the classics and was given the information which follows. Though the root has not been located, -IDES is a common Greek suffix meaning male descendant of. *Cibicides* might therefore be a proper name, e.g. son of Cibex, taken by de Montfort from some obscure classical allusion, and its gender would be masculine. The gallicized form "le cibicide" may be compared with a feminine derivative used by de Montfort on a later page, viz. "la helenide" from *Helenis*. It may be noted that a masculine Latin word *cibicida* exists, meaning 'bread-eater' and used as a nickname for a slave, but *Cibicide* would not be a normal derivative from it, nor is there any clear connection between its meaning and the generic characteristics of *Cibicides*.

This evidence of masculine gender for *Cibicides* calls for amendment to the published names of many of its species and varieties. The following are considered the correct forms of some faulty names included in the Catalogue of Foraminifera:

Originally described under *Cibicides:*

C. carsteni Cushman and Ellisor var. *opimus* C. and E. 1939
C. choctawensis Cushman and McGlamery var. *dorso-involutus* Bellen 1946
C. concentricus (Cushman) var. *texanus* Cushman and Ellisor 1945
C. excavatus Brotzen 1936
C. floridanus (Cushman) var. *compressus* Cushman and Renz 1941
C. ihungius Finlay 1940
C. matutinus Franke 1936
C. mexicanus Nuttall 1932
C. perlucidus Nuttall 1932
C. plano-convexus Cushman and Todd 1945
C. pseudoungerianus (Cushman) var. *io* Cushman 1931
C. refulgens Montfort var. *corticatus* Earland 1934
C. subspiratus Nuttall 1930
C. tuberculatus Natland 1938
C. venezuelanus Nuttall 1935

Transferred from *Anomalina:*

C. cicatricosus (Schwager)
C. oligocaenicus (Herrmann)
C. tenuissimus (Nuttall)
C. variolatus (d'Orbigny)

Transferred from *Pulvinulina:*

C. pygmaeus (Hantken)

Transferred from *Nautilus*

C. lobatulus (Walker and Jacob)

Transferred from *Rotalia:*

C. constrictus (Hagenow)

Transferred from *Rotalina:*

C. involutus (Reuss)
C. ungerianus (d'Orbigny)

Transferred from *Truncatulina:*

C. americanus (Cushman)
C. basilobus (Cushman)
C. beaumontianus (d'Orbigny)
C. concentricus (Cushman)
C. convexus (Reuss)
C. excolatus (Cushman)
C. floridanus (Cushman)
C. nucleatus (Sequenza)
C. refulgens Montfort var. *conicus* (Carsey)
C. robertsonianus (Brady)
C. tenuimargo (Brady) var. *altocameratus* (Heron-Allen and Earland)
C. vermiculatus (d'Orbigny)

In the species *C. advena* (d'Orbigny), *C. nephridium* Tolmachoff 1934, *C. pachyderma* (Rzehak) and *C. padella* Jennings 1936 the specific name is a noun correctly used in apposition to the generic substantive.

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——, 1867, Die fossile Fauna der Steinsalzablagerung von Wieliczka in Galizien. *Idem*, Sitzber., bd. 55, abt. 1, p. 87. Vienna.
——, 1870, Die Foraminiferen des Septarienthones von Pietzpuhl. *Idem*, Sitzber., bd. 62, abt. 1, p. 484. Vienna.

RAYMONDELLA, BANCROFTINA, REEDASPIS

G. WINSTON SINCLAIR
University of Michigan

In 1945, in a posthumous paper, Bancroft described a brachiopod, *Raymondella* "n. gen.," genotype *Raymondella typa* "n. sp." (Bancroft, 1945, pp. 197–198). The next year I stated that this generic name has been previously used, and proposed that it be replaced by *Bancroftina* (Sinclair, 1946, p. 295). This note was impelled mainly by a desire to replace the homonym before it could gain currency, and thus prevent confusion. In my haste I accepted at face value the statements "n. gen." and "n. sp.," without checking further.

Very soon after my note appeared I discovered that Bancroft's names had been used before 1945, and through the kindness of Dr. H. B. Whittington I obtained a photostat of the paper in which Bancroft first used the name *Raymondella*. Since the new information did not affect the status of any of the names, it seemed that correction of the error could wait until there was occasion to discuss the brachiopod genus involved. However, in a paper just received here, Prantl & Přibyl (1948, p. 2) interpret these names differently, and, I think, incorrectly. A full statement of the situation may be useful.

The name *Raymondella* was first proposed by Bancroft in 1933 (p. 3), for a Caradocian brachiopod from Shropshire. The genus was defined very briefly, and the genotype given as "*R. typa*," then a nomen nudum. I am not certain of the status of this little paper, and am not sure that it was ever published in the sense that it was available to the scientific public at large. However, I do not base my rejection of the name as of this date on this point, but on the status of the genotype. Article 25, section 3, of the *Règles* states that no genus proposed after 1930 shall be valid unless there has been a "definite unambiguous designation of the type species." This section has been criticized, and there is some tendency to ignore its strict implication in cases where a genus is otherwise well-founded, and lacks only a literal designation of the type. But the present case is not one of these. I think it obvious that this section demands that there shall be a species in the genus. A definite unambiguous designation of an undescribed species does not make sense. For this reason I think that Bancroft did not validly establish a genus *Raymondella* in 1933.

In 1938 Whittington had occasion to describe a Caradocian brachiopod fauna from Wales. He was able to identify some of his specimens with Bancroft's manuscript species *Raymondella typa*, by comparison with Bancroft's labelled specimens in the British Museum. This identification was only possible because of Whittington's access to the collections, and could not have been made from the literature. Whittington (1938, p. 249) described his fossils as *Raymondella typa* Bancroft 1933, "out of courtesy to Mr. Bancroft." Whittington's dilemma can be readily understood: Bancroft had had this material in manuscript for years, and there was no immediate prospect of its publication (actually this took another seven years), yet the species had to be referred to. The species *typa* is clearly Whittington's and its date 1938. Whittington (p. 242) thought the genus *Raymondella* "adequately defined" by Bancroft, and I agree, in so far as the definition permitted separation of the genus from allied forms, but, as I have indicated, I do not think the original definition was valid in nomenclature. I thus consider *Raymondella* to date from 1938, with Whittington as its author. The genotype is *Raymondella*

typa by original designation (by virtue of its name, Article 30, section b).

Unfortunately, in the meantime Reed (1935, p. 8–9) had erected a trilobite subgenus *Raymondella*.

Prantl & Přibyl have noticed that Bancroft did not use *Raymondella* for the first time in 1945, and they take it to date from 1933. They cite Neave (1940, p. 16) as authority, and possibly did not see Bancroft's 1933 paper. Taking Bancroft's description as valid, they consider Reed's *Raymondella* a junior homonym, and replace it with the new name *Reedaspis*. Since I date the brachiopod 1938, it follows that I consider this new name unnecessary.

As I see it, then, we have:

A trilobite, *Raymondella* Reed 1935, (syn. *Reedaspis* Prantl & Přibyl 1948), and a brachiopod, *Bancroftina* Sinclair 1946, (syn. *Raymondella* Whittington 1938 (not Reed 1935).

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HOMONYMS AND SYNONYMS IN "EARLY UPPER CAMBRIAN FAUNAS OF CENTRAL MONTANA"

CHRISTINA LOCHMAN AND DONALD DUNCAN

At the time of publication of Geological Society of America, Special Paper 54, 1944, it was indicated that the war had prevented the authors from checking certain of their species with the species described by Dr. C. E. Resser in "New Upper Cambrian Trilobites," Smithsonian Miscellaneous Collections, vol. 103, no. 5, 1942. This check has now been made and the authors wish to indicate in this note the recognized synonyms between the species as well as several other nomenclatural corrections. We wish to thank Dr. C. T. Stubblefield for calling to our attention the fact that the name *Pilgrimia* was preoccupied.

In July 1948, in accordance with the wishes of the authors and Dr. Charles Deiss, all the types of Special Paper 54, exclusive of the brachiopods, were deposited permanently in the U. S. National Museum. All the brachiopod types are in the possession of Dr. W. Charles Bell, Department of Geology, University of Minnesota.

The new name *Paracedaria* Duncan is proposed to replace *Pilgrimia* Duncan 1944, p. 107 (not *Pilgrimia* Osborn, 1925). The genotype is *Paracedaria montanensis* (Duncan) 1944, p. 108, pl. 13, figs. 1–6.

Howellaspis Lochman and Denson, 1944, p. 125, is a synonym of *Bolaspidella* Resser, 1937, Smithson. Misc. Coll., vol. 95, no. 22, p. 3. The two species described in 1944 become *Bolaspidella wellsvillensis* (Lochman and Denson), and *Bolaspidella snowyensis* (Duncan).

The species which fall into synonymy are:

Coosia grandis Lochman (p. 47, pl. 6, figs. 23–31) is a synonym of *Coosia dakotensis* Resser (p. 74, pl. 13, figs. 29–31)

Maryvillia aequa Duncan (p. 50, pl. 4, figs. 24, 25) is a synonym of *Maryvillia wyomingensis* Resser (p. 67, pl. 12, figs. 14–20; pl. 14, fig. 1).

Arapahoia convexa Duncan (p. 117, pl. 10, figs. 30–35) is a synonym of *Arapahoia polita* Resser (p. 45, pl. 7, figs. 10–11); *Arapahoia prolixa* Resser (p. 46, pl. 7, figs. 20–26) is also a synonym of *Arapahoia polita* Resser.

Arapahoia neihartensis Lochman (p. 119,

pl. 10, figs. 25–29) is a synonym of *Arapahoia elongata* Resser (p. 45, pl. 7, figs. 16–19, 32)

Arapahoia walcottae Resser (p. 46, pl. 7, figs. 12–14) is a synonym of *Arapahoia snowiensis* Howell and Duncan, 1939, (Wagner Free Inst. Sci., Bull. vol. 14, no. 4, p. 6, pl. 1, fig. 10).

NEW NAMES FOR TWO SPECIES OF FORAMINIFERA FROM LITTLE STAVE CREEK, CLARKE CO., ALABAMA

ORVILLE L. BANDY
University of Southern California

Dr. Hans E. Thalmann has called my attention to the preoccupation of two new specific names in *Eocene and Oligocene Foraminifera from Little Stave Creek, Clarke Co., Alabama*, Bull. Amer. Paleonto., vol. 32, no. 131, March 4, 1949.

The new proposals and references are:

Triloculina pinguis new name to replace *Triloculina subrotunda* Bandy idem, p. 23, pl. 1, fig. 10. The name *Triloculina subrotunda* is preoccupied by *Vermiculum subrotundum* Montagu, 1803 (a *Triloculina*) Test. Brit., p. 521 (figured in Walker and Boys, 1784, Minute Shells, pl. 1, fig. 4).

Lagena parvulipora new name to replace *Lagena elliptica* Bandy, idem., p. 55, pl. 7, fig. 16. The name *Lagena elliptica* is preoccupied by *Lagena apiculata* (Reuss) var. *elliptica* Reuss 1862 (1863), Sitzber, K., Akad. Wiss. Wien, Math.-nat. Cl., vol. 46, Abt. 1, (1862) 1863, p. 35, pl. 2, fig. 2; and by *Lagena orbignyana* (Sequenza) var. *elliptica* Cushman, 1923, U. S. Nat. Mus., Bull. 104, pt. 4, p. 42, pl. 6, figs. 10–12.

JOURNAL OF PALEONTOLOGY, VOL. 23, NO. 4, P. 441, JULY 1949

ERRATA

For: Alexander Stoyanow, Molluscan faunule from Devonian Island Mesa beds, Arizona, Journal of Paleontology, Vol. 22, no. 6, pp. 783–791, pls. 120, 121, November 1948.

p. 783 right hand column line 24 from bottom:

(Conrad), *Pl. 121*, fig. 30.

p. 787 left hand column lines 30–33 from top:

abruptly from the carinae to the anterior *margin* thus forming the anterior face of the *shell* with appreciable depressions between the carinae and the scute.

p. 788 right hand column line 2 from top:

. posterolateral teeth also are *distant* from

For: Weldon W. Rau, Foraminifera from the Miocene Astoria formation in southwestern Washington, Journal of Paleontology vol. 22, no. 6.

p. 781, column 1, line 17: Plate 119, figures 18–20 should read: Plate 119, figures 15–17.

p. 778: the name *Bolivina astoriensis* is preoccupied by a form illustrated and described by Cushman, Stewart, and Stewart, 1947, Oregon State Dept. of Geology and Mineral Resources, Bull. 36. Therefore the name *Bolivina chehalisensis* Rau is proposed in place of *Bolivina astoriensis* Rau.

JOURNAL OF PALEONTOLOGY, VOL. 23, NO. 4, PP. 442–452, JULY 1949

SOCIETY RECORDS AND ACTIVITIES

REPORTS AND MINUTES OF THE TWENTY-THIRD ANNUAL MEETING OF THE SOCIETY OF ECONOMIC PALEONTOLOGISTS AND MINERALOGISTS

The twenty-third annual meeting of the Society of Economic Paleontologists and Mineralogists was held in St. Louis, Missouri, March 14–17, 1949, in conjunction with the annual meeting of The American Association of Petroleum Geologists.

The Presidential Address of the Society, "Trends in Sedimentology," was given by R. Dana Russell in the joint session on Tuesday, March 15, 1949.

The first part of the technical program of the Society, with R. Dana Russell presiding, began at 9:00 A.M., Wednesday, March 16, and continued until 12 noon. The following papers were presented.

Quaternary of Gulf of Mexico

Shepard W. Lowman, "Sedimentary facies of Gulf Coast"

Harold N. Fisk, "Depositional environments of Mississippi delta"

Henry C. Stetson, "Sediments of western half of Gulf of Mexico"

Fred B. Phleger, Jr., "Distribution of foraminifera in Northwestern Gulf of Mexico"

Parker D. Trask, "Recent sediments in Gulf of Mexico as source beds of petroleum"

(The S.E.P.M. met with the A.A.P.G. for a Symposium on Reefs, Wednesday, March 16, from 2:00 to 5:00 P.M.)

The second part of the technical program, with G. E. Condra, W. C. Krumbein, and Mrs. Betty K. Nadeau presiding, was presented from 9:00 until 11:30 A.M., and from 2:00 until 5:00 P.M., Thursday, March 17. The following papers were given.

Fundamental Problems in Paleontology

M. P. White, "A Fusulinid slide rule"

A. K. Miller, "Role of Paleozoic ammonoids in pure and applied geology"

L. L. Sloss, "Rates of evolution and measurement of geologic time"

Rousseau H. Flower, "Phylogeny and stratigraphy"

Maxim K. Elias, "State of paleontology"

This symposium was followed by discussions, in which H. B. Stenzel and N. D. Newell participated, and summarized by G. E. Condra on Thursday afternoon.

The following papers were given in a parallel session Thursday afternoon.

Sherman A. Wengerd, "Correlation of specific gravity and lithology in Viola rocks"

Brooks F. Ellis, "Micro-fossil clearing house"

Gordon Rittenhouse, "Sedimentary facies in early Silurian rocks of Northern Appalachian Basin"

Cecil G. Lalicker, "Foraminifera of Ellis formation at type locality"

F. T. Connolly, "Petrography and paleogeography of McClosky sand in Passport Oil Pool, Clay County, Illinois"

Raymond E. Peck, "Geological history of Charophyta"

E. C. Dapples, L. L. Sloss, W. C. Krumbein, "Organization of sedimentary rocks"

Edward J. Zeller, "Endothyroid Foraminifera from Madison and Brazer formations of Utah"

Henry F. Nelson, "Insoluble residues of Comanche Peak and Edwards limestones of Bell, Coryell and McLennan counties, Texas"

The following paper was read by title.

J. Harlan Johnson and W. Alan Stewart, "Eocene coralline Algae from Meganos formation, California"

The meeting adjourned at 5:00 P.M.

The annual business session of the Society was called to order at 11:30 A.M., Thursday, March 17, by R. Dana Russell, and on suggestion of H. A. Ireland, roll was taken of the members present.

The minutes of the 1948 meeting were approved as published in the *Journal of Paleontology*, Vol. 22, No. 4 (July, 1948).

The following reports were given.

1. *Report of the Editor of the Journal of Paleontology* (*J. Marvin Weller*).—Volume 22 of the *Journal of Paleontology*, issued in conjunction with the Paleontological Society

in 1948, contains 813 pages and 123 collotype plates. Published in it are 64 paleontological papers, 1 paper on classification, 1 bibliography, 12 paleontological notes, 4 notes on techniques, 12 nomenclatural notes, 3 reviews, data relating to the activities and memberships of the two societies, and other miscellaneous material.

The March, July, and November numbers were prepared by your editor on behalf of the Society of Economic Paleontologists and Mineralogists. These numbers consist of 483 pages and 60 collotype plates, an increase of 150 pages and 24 plates as compared with the previous volume. The contributions in these numbers may be classified as follows.

	Paleozoic	*Mesozoic*	*Cenozoic*
Protozoa		4	
Hydrozoa	1		
Conodonts	2		
Crinoids	2		
Asteroids		1	
Brachiopods			1
Pelecypods	1		1
Gastropods	1		
Cephalopods	2		
Trilobites	3		
Eurypterids	1		
Ostracodes		2	3
Plants	1		1
Undet.			1

Nine of these describe or name fossils from foreign countries. In addition, nine are devoted to bibliography, quantitative paleontology, classification, the status of paleontology, nomenclature, techniques, and obituary.

Volume 1 of the *Journal*, long unavailable, has been reprinted and copies may be purchased at the Society headquarters. The preparation of a subject index to the first 20 volumes of the *Journal* has been announced previously. The preparation of an index to all genera and species described in these volumes has been undertaken by Hans Thalmann and is well on the way to completion. Both of these should be ready for publication before the end of the year.

2. *Report of the Editor of the Journal of Sedimentary Petrology* (*W. H. Twenhofel*)—During the year 1948 the *Journal of Sedimentary Petrology* published twenty articles totalling 117 printed pages. In addition, there were notices and reviews totalling 13 pages. Few manuscripts were submitted in early 1948; this was corrected in the latter part of the year and more manuscripts were submitted than could be published. The outlook for 1949 is excellent.

3. *Report of the Secretary-Treasurer* (*H. B. Stenzel*).—

BACK VOLUME SALES

Back volumes of the Journal of Paleontology	$3,593.35
Back volumes of the Journal of Sedimentary Petrology	896.70

PRINTING AND ENGRAVING BILLS FOR 1948

Journal of Paleontology

	Banta Printing Bills	*Meriden Engraving Bills*	*Total Printing and Engraving Bills*	*S.E.P.M. Total Printing and Engraving Bills*
Number 1 (January)*	$1,149.95	$ 759.92	$ 1,909.87	
Number 2 (March)	1,709.64	377.71	2,087.35	$2,087.35
Number 3 (May)*	1,191.43	797.23	1,988.66	
Number 4 (July)	1,643.50	573.07	2,216.57	2,216.57
Number 5 (September)*	1,211.39	496.84	1,708.23	
Number 6 (November)	2,247.91	721.62	2,969.53	2,969.53
	$9,153.82	$3,726.39	$12,880.21	$7,273.45
(1947 Totals)	($6,101.17)	($2,646.72)	($ 8,747.89)	($4,482.98)

* Odd numbers paid by Paleontological Society.

Journal of Sedimentary Petrology

Number 1 (April)	$ 506.01
Number 2 (August)	438.31
Number 3 (December)	652.51
	$1,596.83
(1947 Total)	($1,275.17)

MEMBERSHIP, MAILING, AND JOURNAL STATISTICS

	March 1949	*March 1948*	*March 1947*
1. S.E.P.M. Membership:			
Active Members	380	321	306
Associate Members	146	101	90
TOTAL	526	422	396
2. Journal of Paleontology Mailing List:			
S.E.P.M. Active Members	261	239	230
S.E.P.M. Associate Members	84	67	58
Subscribers	497	464	371
P.S. Members	393	395	351
TOTAL	1,235	1,165	1,010
3. Journal of Sedimentary Petrology Mailing List:			
S.E.P.M. Active Members	209	166	156
S.E.P.M. Associate Members	66	38	31
Subscribers	422	378	266
TOTAL	697	582	453

4. Number of pages in 1948 Journal of Paleontology	813 (603, 1947)
5. Number of plates in 1948 Journal of Paleontology	124 (84, 1947)
6. Total edition of 1948 Journal of Paleontology	1,500 (1,400, 1947)
7. Number of pages in 1948 Journal of Sedimentary Petrology	130 (139, 1947)
8. Total edition of 1948 Journal of Sedimentary Petrology	800 (700, 1947)
New Members from March 1, 1948, to March 1, 1949	62 (24, 1947–1948)
New Associates from March 1, 1948, to March 1, 1949	54 (17, 1947–1948)
Transfers to active membership, March 1, 1948, to March 1, 1949	5 (3, 1947–1948)
Reinstatement to active membership, March 1, 1948, to March 1, 1949	0 (1, 1947–1948)

CERTIFICATE OF INDEPENDENT PUBLIC ACCOUNTANTS

To the Council

Society of Economic Paleontologists and Mineralogists:

We have examined the balance sheet of SOCIETY OF ECONOMIC PALEONTOLOGISTS AND MINERALOGISTS at December 31, 1948 and the related statement of income and surplus for the year then ended. Our examination was made in accordance with generally accepted auditing standards, and accordingly included such tests of the accounting records and such other auditing procedures as we considered necessary in the circumstances.

In our opinion, the accompanying balance sheet and statement of income and surplus present fairly the financial position of SOCIETY OF ECONOMIC PALEONTOLOGISTS AND MINERALOGISTS at December 31, 1948, and the results of its operations for the year then ended, in conformity with generally accepted accounting principles applied on a basis consistent with that of the preceding year.

ARTHUR YOUNG & COMPANY

TULSA, OKLAHOMA,
January 28, 1949

FINANCIAL STATEMENT FOR THE YEAR ENDED DECEMBER 31, 1948

BALANCE SHEET
AT DECEMBER 31, 1948

ASSETS

CURRENT ASSETS:		
Demand deposits		$ 5,391.04
Savings deposit		2,322.49
Accounts receivable less reserve, $15.87		189.55
Total current assets		$ 7,903.08
PUBLICATIONS:		
Journals of Paleontology:		
Issued prior to 1948—22,914 journals at $.50 each (3,813 complete volumes)	$11,457.00	
Issues 1 to 6 of 1948—1,151 journals at cost	1,628.95	
Reprints in 1948, Volume 1, 1927—949 volumes at cost	2,100.87	
Journals of Sedimentary Petrology:		
Issued prior to 1948—2,947 journals at $.50 each (996 complete volumes)	1,473.50	
Issues 1 and 2 of 1948—115 journals at cost	70.44	16,730.76
FURNITURE AND FIXTURES less reserve, $539.43		1.00
DEFERRED CHARGES		388.79
		$25,023.63

LIABILITIES AND SURPLUS

CURRENT LIABILITIES:		
Accounts payable		$ 2,369.24
Amount payable to Paleontological Society		1,595.32
Total current liabilities		$ 3,964.56
DEFERRED INCOME:		
Subscriptions to journals	$ 2,544.57	
Membership dues for 1949 and 1950	1,806.05	4,350.62
SURPLUS (per attached statement)		16,708.45
		$25,023.63

STATEMENT OF INCOME AND SURPLUS FOR THE YEAR ENDED DECEMBER 31, 1948

INCOME:		
Membership dues and subscriptions:		
Journal of Paleontology and Sedimentary Petrology	$ 1,024.00	
Journal of Paleontology	4,279.43	
Journal of Sedimentary Petrology	1,724.77	$ 7,028.20
Sale of back numbers:		
Journal of Paleontology, Volume 1, 1927 (251 reprints)	$ 1,567.85	
Journal of Paleontology, Volumes 2–22 (1928–1948)	1,879.20	
Journal of Sedimentary Petrology	870.03	4,317.08
Sales of plates and reprints		343.37
Advertising		156.23
Miscellaneous		31.06
		$11,875.94
Less: Proportion of income accrued to Paleontological Society		1,595.32
		$10,280.62

COSTS AND EXPENSES		
Cost of printing:		
Journal of Paleontology, Volume 1, 1927—1,200 reprints (949 on hand)	$2,849.64	
Journal of Paleontology, Volume 22, 1948	7,102.33	
Journal of Sedimentary Petrology	1,210.78	
	$11,162.75	
Clerical salaries	1,756.25	
Office supplies and expenses	266.64	
Office rent	737.25	
Postage and express	393.19	
Insurance and bond	42.79	
Audit fee	100.00	
Taxes	31.63	
Depreciation	46.09	
Miscellaneous	69.32	
	$14,605.91	
Adjustment for increase in inventory of publications	1,575.76	13,030.15
NET (LOSS)		*($ 2,749.53)*
SURPLUS AT DECEMBER 31, 1947		19,457.98
SURPLUS AT DECEMBER 31, 1948		$16,708.45

It was moved, seconded, and approved that the reports be accepted.

4. *Report of the Research Committee* (*M. L. Natland, Chairman*).—President Russell appointed the following men on the Research Committee of the S.E.P.M. in June, 1948: Manley L. Natland, chairman, William C. Krumbein, Leslie W. LeRoy, Shepard W. Lowman, Fred B. Phleger, Jr., Roger R. Revelle, F. W. Rolshausen, W. H. Twenhofel, Stanley G. Wissler.

The subject chosen for the symposium for the 1949 meeting in St. Louis was, "Quaternary of Gulf of Mexico."

Five excellent papers were presented at St. Louis to approximately 200 people on the morning of March 16. The papers were very favorably received and were as follows:

Shepard W. Lowman, "Sedimentary facies of Gulf Coast"

Harold N. Fisk, "Depositional environments of Mississippi delta"

Henry C. Stetson, "Sediments of western half of Gulf of Mexico"

Fred B. Phleger, Jr., "Distribution of Foraminifera in Northwestern Gulf of Mexico"

Parker D. Trask, "Recent sediments in Gulf of Mexico as source beds of petroleum"

The meeting of the Research Committee was held Tuesday afternoon, March 15, in the Jefferson Hotel. In addition to the committee members there were approximately fifteen others present. The chairman presented lantern slides and geologic cross sections to illustrate the need for study of certain phases of sedimentation and ecology. Considerable discussion followed and the general title, "Problems in Marine Geology," was selected for the 1950 symposium to be held in Chicago.

The membership of the Research Committee for 1949–1950 is unchanged except for the addition of one new member, Mr. Harry S. Ladd.

It was moved, seconded, and approved that the secretary be instructed to send a letter of thanks to the chairman of the Research Committee.

5. *Report of the Committee on Members and Papers* (*M. N. Bramlette, Chairman*).—The functions of this committee, according to the President's letter of June 11, 1948, to prospective committee members, are to obtain additional members for the Society and to obtain scientific papers of value for publication in the *Journal of Paleontology* and the *Journal of Sedimentary Petrology*. Suggestions for improvement of the *Journals* were also solicited.

Initially, efforts were directed primarily at staff members and graduate students in colleges and universities. Letters were sent out on September 27 and December 28, 1948, to the 34 members of the committee. Replies from many of the members in-

dicated interest in aiding the program, but concrete results are best known to the business office. [The membership, active and associate, increased by 113 (422 to 535) from March, 1948, to the close of the annual meeting, March, 1949, and the editors report an increase in the number of papers submitted. A large portion of this gain can be attributed to the work of the committee —RDR.]

It was also considered that the large number of geologists working in oil company laboratories were not adequately represented in the Society, so the activities of the committee were subsequently extended to this group. Messrs. F. W. Rolshausen and James A. Waters compiled lists of workers in the Gulf Coast, Mid-Continent, and South America, but time has not been available to contact more than a few laboratories. Letters have been written to members in Venezuela laboratories and laboratories in California have also been contacted. Many more on these lists can doubtless be interested in joining the Society if the work of the committee is continued.

I am glad to have been able to assist in this work and regret very much that time did not permit additional activity. Since I will not have time to continue, I request that I be relieved as chairman of the committee. All lists, correspondence, and other data will be forwarded to the new chairman designated by the incoming officers of the Society.

It was moved, seconded, and approved that this report be accepted and that the secretary be instructed to detail a letter of thanks to the chairman of the committee.

It was moved, seconded, and approved that a letter of thanks be written to M. P. White, chairman of the Program Committee.

It was moved by Wilbur D. Rankin, seconded, and after discussion, approved unanimously that the price of back numbers of the *Journal of Sedimentary Petrology* be raised to $1.35 per number for members and $1.75 per number for non-members, effective immediately.

It was moved by J. Marvin Weller, seconded, and approved unanimously that the price of back numbers of the *Journal of Paleontology*, volumes 2 to 11, inclusive, be raised to $1.50 per number to members and $2.00 to non-members, effective immediately, and that the Society favor an equal increase for later back numbers subject to approval by the Paleontological Society.

It was moved by John R. Sandidge, seconded, and unanimously approved that the membership approve the council's recommendation that subscription rates of the *Journal of Paleontology* be raised to $10.00 per annum and those of the *Journal of Sedimentary Petrology* be raised to $5.00 per annum beginning with January 1, 1950.

It was moved by H. A. Ireland, seconded, and unanimously approved that By-Law Article I, Number 2, be changed to read as follows, said change to become effective on January 1, 1950.

"2. The annual dues of members and associates of the Society who desire only the JOURNAL OF PALEONTOLOGY shall be six dollars ($6.00). The annual dues of members and associates who desire only the JOURNAL OF SEDIMENTARY PETROLOGY shall be four dollars ($4.00). Members and associates may receive both Journals by the payment of ten dollars ($10.00). Members of the Society, who are also members of the Paleontological Society and receive the JOURNAL OF PALEONTOLOGY through the latter society, may retain membership in the Society of Economic Paleontologists and Mineralogists by the payment of one dollar ($1.00) per year dues. The annual dues are payable in advance on the first day of each calendar year. A bill shall be mailed to each member and associate before January 1 of each year, stating the amount of annual dues and the penalty and conditions for default of payment. Members and associates who shall fail to pay their annual dues by April 1 shall not receive further copies of either JOURNAL, nor shall they be privileged to buy Society publications at special discount made to the membership, until such arrears are met."

It was moved, seconded, and approved that the following Article IX of the By-Laws be enacted herewith.

"Article IX. Directors of American Geological Institute

1. The President of the Society shall

become a Director of the American Geological Institute at the close of that Annual Meeting of said Institute which follows his term as President. He shall represent the Society on said Institute and shall serve in that capacity for two years, a year being construed as the period extending from the close of one Annual Meeting of said Institute to the close of the next in accordance with Article IV, Number 2, of the Articles of Organization of the American Geological Institute.

2. In the event of a vacancy by resignation, death, or other causes among the two Directors who represent the Society on said Institute, the President of the Society shall nominate a Director from the ranks of associate or active members of the Society, and this Director shall complete the unexpired term."

Following a discussion of PS-SEPM relationship by R. Dana Russell and Frank M. Swartz, it was moved, seconded, and approved that the incoming council be authorized to conduct negotiations with the Paleontological Society council leading to better coordination between the two Societies.

It was moved by Wilbur D. Rankin, seconded, and approved that the secretary be instructed to send a letter of thanks to John B. Reeside for his services to the Society as Director of the American Geological Institute during the past year.

R. Dana Russell announced that as a result of the recent mailed ballot, W. H. Twenhofel had been elected to Honorary Membership, and Percival Allen, Cambridge, England; D. J. Doeglas, Wageningen, Holland; J. J. Bourcart, Paris, France; R. Tavernier, Gand, Belgium; and Carl W. Correns, Gottingen, Germany, had been elected Correspondents of the Society.

The results of the election of officers by mailed ballot, for the new year, were announced by outgoing President Russell as follows: President, H. B. Stenzel; Vice-President, Wilbur D. Rankin; Secretary-Treasurer, Cecil G. Lalicker.

The business session adjourned at 12:25 P.M., Thursday, March 17, 1949.

THE SOCIETY OF ECONOMIC PALEONTOLOGISTS AND MINERALOGISTS

A DIVISION OF THE AMERICAN ASSOCIATION OF PETROLEUM GEOLOGISTS

Box 979, Tulsa, Oklahoma

CONSTITUTION

ARTICLE I. NAME

The Society shall be known as the Society of Economic Paleontologists and Mineralogists.

ARTICLE II. OBJECT

The object of the Society shall be to promote the science of stratigraphy through research in paleontology and sedimentary petrology, especially as these relate to development of knowledge of the geology of petroleum.

ARTICLE III. MEMBERSHIP

1. The Society shall be composed of active members, associate members, honorary members, correspondents, and patrons.

2. Active members shall be persons engaged in paleontologic, petrographic, or stratigraphic studies as applied to the geology of petroleum and who have been duly elected members or associate members in the American Association of Petroleum Geologists.

Active members alone shall be known as members.

3. Associate members shall be known as associates. Any person engaged in paleontologic, petrologic, or stratigraphic studies that have application to the geology of petroleum is eligible for associate membership. Associates shall enjoy all the privileges of membership in the Society, save that they shall not hold office, sign applications for membership, or vote.

4. Honorary members shall be persons of distinguished achievement whose contributions to paleontology, petrology, and stratigraphy have an application to the geology of petroleum.

5. Correspondents shall be persons not resident in North America who have made distinctive contributions to paleontology, petrology, and stratigraphy that have application to the geology of petroleum.

6. Patrons shall be persons who have bestowed important favors on the Society.

ARTICLE IV. OFFICERS

1. Executive authority of the Society is vested in a council consisting of five members, duly elected officers, as follows: president, vice-president, secretary-treasurer, and the two most recently retired past-presidents.

2. The president shall discharge the usual duties of a presiding officer at all meetings of the Society and council.

3. The vice-president shall assume the duties of the president in case of his absence.

In the event of the absence from the meetings of both president and vice-president the duties of presiding officer shall fall upon one of the other members of the council in the following order: most recent past-president, second most recent past-president, secretary-treasurer.

4. The secretary-treasurer shall keep record of the proceedings of the Society, and a complete list of the membership. He shall attend to the preparation and mailing of notices and other materials required in the business of the Society. The secretary-treasurer shall have custody of all funds of the Society, and shall keep a detailed account of receipts and disbursements.

5. The council shall consider all nominations for membership and pass on the qualifications of the applicants; shall have control and management of the affairs and funds of the Society; shall determine the manner of publication and pass on the material presented for publication; and shall designate the place of the annual meeting. It is empowered to establish a business headquarters for the Society and to employ such persons as are needed to conduct the business of the Society.

6. Elections shall be held annually to select a president, vice-president, and secretary-treasurer.

ARTICLE V. MEETINGS

1. The Society shall hold at least one stated meeting a year, which shall be designated as the annual meeting. The time and place of the annual meeting shall be designated by the council, but in general, it shall be held in connection with the annual meeting of the American Association of Petroleum Geologists.

2. The annual meeting shall be devoted to the reading and discussion of scientific papers, to the transaction of Society business, and other appropriate functions.

3. The program for the annual meeting shall be arranged by the council, or under its direction.

ARTICLE VI. SECTIONS

1. Local sections of the Society may be established according to provisions of the by-laws.

ARTICLE VII. AMENDMENTS

The constitution may be amended by a two-thirds vote of returned mail ballots received by the secretary-treasurer sixty days after proposal of amendments with provision for vote is mailed to the membership; provided that the proposed amendment has been signed by at least twenty members, and provided further that the proposed amendment must first have the approval of the council, and the executive committee of the American Association of Petroleum Geologists.

BY-LAWS

ARTICLE I. DUES

1. The fiscal year of the Society shall correspond with the calendar year.

2. The annual dues of members and associates of the Society who desire only the JOURNAL OF PALEONTOLOGY shall be five dollars ($5.00). The annual dues of members and associates who desire only the JOURNAL OF SEDIMENTARY PETROLOGY shall be three dollars ($3.00). Members and associates may receive both Journals by the payment of eight dollars ($8.00). Members of the Society, who are also members of the Paleontological Society and receive the JOURNAL OF PALEONTOLOGY through the latter society, may retain membership in the Society of Economic Paleontologists and Mineralogists by the payment of one dollar ($1.00) per year dues. The annual dues are payable in advance on the first day of each calendar year. A bill shall be mailed to each member and associate before January 1 of each year, stating the amount of annual dues and the penalty and conditions for default of payment. Members and associates who shall fail to pay their annual dues by April 1 shall not receive further copies of either JOURNAL, nor shall they be privileged to buy Society publications at special discounts made to the membership, until such arrears are met.

3. Honorary members, correspondents, and patrons may be nominated by a vote of four members of the Council and such nomination shall be submitted to the members by mail ballot. Provided eighty per cent or more of the returned ballots are favorable, the nominee shall be declared elected. Honorary members, correspondents, and patrons shall not be required to pay annual dues.

ARTICLE II. DUTIES AND PRIVILEGES OF MEMBERS

1. Members and associate members dropped for non-payment of dues may apply to the council for reinstatement, and, provided settlement is made of any outstanding indebtedness for publications and other charges approved by the council, may be reinstated by vote of four members of the council.

2. Members shall be eligible to receive publications of the Society at special subscription rates as authorized by the council or as provided in these by-laws.

3. The council is authorized to transmit without charge such publications as it may direct to honorary members, correspondents, and patrons.

4. Only active members shall have the right to vote in electing officers and in transacting the business of the Society.

ARTICLE III. OFFICERS

1. Nominations for officers shall be made in the following manner. Prior to September 1 of each year, the president shall designate

two nominating committees, instructing each committee to submit nominations for president, vice-president, and secretary-treasurer, these nominations to be in the secretary's hands before September 15. If desired, the same person may be nominated by the two committees for the office of secretary-treasurer, but nominations for president and vice-president shall not include the name of the same person on the two slates. The nominations of the first committee to file its report will have precedence in case of overlapping nominations and the other committee shall then be requested to change its nomination.

2. Ballots containing the nominations for officers, alphabetically arranged under each office, shall be prepared by the secretary-treasurer and mailed to each member of the Society on or before October 1. Neither the ballot nor the enclosing envelope need contain the name of the voting member, but an outer envelope that contains the sealed ballot must bear the name of the voting member. The returned ballots received by the secretary-treasurer on or before December 1 shall be counted by him, and if requested, shall be submitted to recount by the council. A plurality of the votes received for any office constitutes election.

ARTICLE IV. PUBLICATIONS

1. The council is authorized and directed to make such arrangements for editorial preparation of manuscripts, publication, distribution, general business management of publications, and all other proper matters connected with efficient handling of publications of the Society not provided for in the constitution as it shall deem desirable in the Society's interest. This includes designation of an editor or editors, who shall serve at the pleasure of the council in the formulation of publication policies, including the making of contracts for printing and engraving, entering into agreements with other scientific societies for joint publication, and acceptance of advertising at determined rates. The council shall supply the editor or editors with a publication budget at the annual meeting of the Society. This budget may be expanded or contracted at later date by vote of the council. In this matter, and in other matters affecting publication policy, the editor or editors will be given the same vote as members of the council.

2. The JOURNAL OF PALEONTOLOGY and the JOURNAL OF SEDIMENTARY PETROLOGY are designated as official publications of the Society. The council is not authorized to initiate and publish other periodicals.

3. A publication fund may be established consisting of an assignment of a portion of dues as designated by the council, and such donations as are specifically made for that purpose. The council is authorized to provide special publications from this fund as may be deemed desirable, and to fix terms for sale or other distribution of these publications.

ARTICLE V. FINANCIAL METHODS

1. No financial obligations shall be contracted without express sanction of the Society or council, but all ordinary incidental running expenses have sanction without special action.

2. Statements of accounts charged to the Society, other than miscellaneous running expenses, shall be approved by the president before the secretary-treasurer pays the amount out of funds of the Society not otherwise appropriated, and the receipted bill shall be held as the secretary-treasurer's voucher.

3. The secretary-treasurer shall have charge of the financial affairs of the Society and shall annually submit reports as secretary-treasurer covering the fiscal year. He shall receive all funds of the Society, and, under the direction of the council, shall disburse all funds of the Society. He shall cause an audit to be prepared annually by a public accountant at the expense of the Society. He shall give a bond, and shall cause to be bonded all employees to whom authority may be delegated to handle Society funds. The amount of such bonds shall be set by the council and the expense shall be borne by the Society. The funds of the Society shall be disbursed by check as authorized by the council.

ARTICLE VI. BUSINESS REPRESENTATIVES

1. The president and the secretary-treasurer of the society shall act as business representatives of the Society in the business

committee of the American Association of Petroleum Geologists. These representatives shall conduct such business with the executive committee of the Association as is of mutual interest to the Society and the Association in the interims between the annual meetings of the Society and the Association. Approval of the action of these representatives on the part of the Society during any year is reserved to the council in session at the annual meeting at the close of that year. Questions remaining unsettled between the representatives of the Society and the executive committee of the Association shall be considered in a joint meeting of the Council of the Society or its authorized representatives and the executive committee of the Association at the annual meeting of the Association at the close of the interim period during which such questions have arisen.

ARTICLE VII. SECTIONS

1. The establishment of local sections of the Society may be authorized by unanimous vote of the council approving a petition for such establishment signed by ten members of the Society. Such local sections may elect officers, conduct meetings, and engage in other scientific activities, but shall not be entitled to special representation in general Society affairs.

2. The council is authorized and directed to withdraw the charter of any established local section if there is evidence that it has become inactive.

ARTICLE VIII. AMENDMENTS

1. The by-laws may be amended at any annual business meeting by two-thirds vote of the members present, or by mail ballot sent to the members, in which case two-thirds of the returned ballots received in sixty days after mailing must approve the amendment in order to make it effective. Any proposed changes to the by-laws must first have the approval of the council.

ARTICLE IX. DIRECTORS OF AMERICAN GEOLOGICAL INSTITUTE

1. The president of the Society shall become a director of the American Geological Institute at the close of that annual meeting of said Institute which follows his term as president. He shall represent the Society on said Institute and shall serve in that capacity for two years, a year being construed as the period extending from the close of one annual meeting of said Institute to the close of the next in accordance with Article IV, Number 2, of the Articles of Organization of the American Geological Institute.

2. In the event of a vacancy by resignation, death, or other causes among the two directors who represent the Society on said Institute, the president of the Society shall nominate a director from the ranks of associate or active members of the Society, and this director shall complete the unexpired term.

OFFICERS OF THE SOCIETIES

THE SOCIETY OF ECONOMIC PALEONTOLOGISTS AND MINERALOGISTS

For the year ending April 1950

President, H. B. STENZEL, Austin, Tex.

First Past-President, R. DANA RUSSELL, San Diego, Calif.

Second Past-President, JAMES A. WATERS, Dallas, Tex.

Vice-President, WILBUR D. RANKIN, Los Angeles, Calif.

Secretary-Treasurer, CECIL G. LALICKER, Lawrence, Kans.

Editors

J. MARVIN WELLER, Chicago, Ill., for paleontology.

W. H. TWENHOFEL, Orlando, Fla., for mineralogy.

THE AMERICAN ASSOCIATION OF PETROLEUM GEOLOGISTS

For the year ending April 1950

President, C. W. TOMLINSON, Ardmore, Okla.

Past-President, PAUL WEAVER, Houston, Tex.

Vice-President, THEODORE A. LINK, Toronto, Ont.

Secretary-Treasurer, HENRY N. TOLER, Jackson, Miss.

Editor, ALFRED H. BELL, Urbana, Ill.

THE PALEONTOLOGICAL SOCIETY

For the year ending November 1949

President, WINIFRED GOLDRING, Albany, N. Y.

Vice-President, NORMAN D. NEWELL, New York, N. Y.

Secretary, H. E. VOKES, Baltimore, Md.

Treasurer, FRANK M. SWARTZ, State College, Pa.

Editor, A. SCOTT WARTHIN, Poughkeepsie, N. Y.

Chairman, Pacific Coast Section, W. H. EASTON, Los Angeles, Calif.

Ex-Presidents

J. BROOKES KNIGHT, Washington, D. C., 1946.
R. C. MOORE, Lawrence, Kans., 1947.
W. P. WOODRING, Washington, D. C., 1948.

JOINT COMMITTEE ON ZOOLOGICAL NOMENCLATURE FOR PALEONTOLOGY IN AMERICA

Sponsored by the Society of Economic Paleontologists and Mineralogists, The Paleontological Society, and the Society of Vertebrate Paleontology in support of the International Commission on Zoological Nomenclature.

Policy Board

G. WINSTON SINCLAIR, *Chairman* (PS);
R. C. MOORE (PS); A. S. ROMER (SVP)

Members

D. L. FRIZZELL A. MYRA KEEN KATHERINE V. W. PALMER ALFRED S. ROMER	1947–1949
RAYMOND C. MOORE J. BROOKES KNIGHT G. WINSTON SINCLAIR JOHN W. WELLS	1948–1950
DAVID H. DUNKLE S. W. MULLER J. M. WELLER J. B. RERSIDE, JR.	1949–1951

Address all communications to the chairman, G. WINSTON SINCLAIR, University of Michigan, Ann Arbor, Mich.

THE GEOLOGICAL SOCIETY OF AMERICA

For the year ending November 1949

President, CHESTER R. LONGWELL, Yale University, New Haven, Conn.

Past-President, JAMES GILLULY

Vice-Presidents

W. W. RUBEY
A. O. WOODFORD
W. P. WOODRING
M. A. PEACOCK

Secretary, H. R. ALDRICH, New York, N. Y.

Treasurer, J. EDWARD HOFFMEISTER, Rochester, N. Y.

Councillors

C. A. ANDERSON, Prescott, Ariz. ERNEST CLOOS, Baltimore, Md. M. KING HUBBERT, Houston, Tex.	1947–1949
G. M. FOWLER, Joplin, Mo. F. J. PETTIJOHN, Chicago, Ill. EARL INGERSON, Washington, D.C.	1948–1950
JOHN W. AMBROSE S. W. MULLER THOMAS B. NOLAN	1949–1951

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COMPREHENSIVE INDEX

OF THE PUBLICATIONS OF
THE AMERICAN ASSOCIATION OF PETROLEUM GEOLOGISTS
1917-1945

By DAISY WINIFRED HEATH

A.A.P.G. PUBLICATIONS INDEXED

1917–1945	The *Bulletin*, Vol. 1 (1917)-Vol. 29 (1945)
1926	Geology of Salt Dome Oil Fields
1928	Theory of Continental Drift
1929	Structure of Typical American Oil Fields, Vol. 1
1929	Structure of Typical American Oil Fields, Vol. 2
1931	Stratigraphy of Plains of Southern Alberta
1933	Geology of California
1934	Problems of Petroleum Geology
1935	Geology of Natural Gas
1936	Geology of the Tampico Region, Mexico
1936	Gulf Coast Oil Fields
1936	Structural Evolution of Southern California
1938	Miocene Stratigraphy of California
1939	Recent Marine Sediments
1941	Possible Future Oil Provinces of the United States and Canada
1941	Stratigraphic Type Oil Fields
1942	Permian of West Texas and Southeastern New Mexico
1942	Source Beds of Petroleum

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